TA 2.4: Outline Peat Management Plan

Technical Appendix 2.4: Outline Peat Management Plan

1.1 Introduction

1.1.1 The outline Peat Management Plan (PMP) has been prepared in accordance with appropriate guidance and best practice[1,2].

1.1.2 This outline PMP should be read in conjunction with the Outline Construction Environmental Management Plan (CEMP) (Technical Appendix 2.1) and the various other reports that contribute to it, including the Peat Depth Survey Report (Technical Appendix 2.3) and Peat Landslide Hazard Risk Assessment (PLHRA) (Technical Appendix 2.5).

1.1.3 The outline PMP describes principles and methods to be used by the Applicant when excavating, moving and reinstating peat. It includes a volumetric peat balance and contains requirements for the final PMP, that will be developed by the contractor post consent, prior to construction. A final PMP will be produced by the Applicant's infrastructure Contractor.

1.1.4 The overarching aim of the PMP is to provide guidance and a framework for the contractor to effectively reuse peat excavated during construction in order to maintain and improve peatland habitats, minimise the risks to water quality and volumes, and retaining and using peat as close as possible to the point of extraction. The main requirement for the contractor is to plan peat management in detail and incorporate its progressive reinstatement and restoration of adjacent peatland areas into the construction programme so that they take place concurrently, minimising time the peat is in temporary storage and avoiding double-handling of peat.

1.2 Summary of Peat Depth

1.2.1 Most of the developable area of the Site has either no peat present or has a shallow depth of peat soil present (~88% <0.5 m in depth). Whilst the majority of the coverage is relatively shallow, the maximum depth of peat recorded at the Site was 5.2 m, located in the central part of the Site, south of Craig Watch and west of Brown Hill. The mean peat depth recorded was 0.31 m. The design of the Proposed Development has taken into consideration peat depths, along with other technical and environmental constraints, and the Proposed Development's infrastructure has been sited away from these areas, where possible.

1.3 Limitations

1.3.1 Peat probing and mapping have been used to inform the design process, at strategic points in the design evolution of the Proposed Development. However, there are some differences between the final design and the extent of the peat survey results based on design changes made through this process, as a result of micrositing etc.

1.3.2 However, the peat survey probing points do provide high resolution coverage of the Site, and these revealed the peatland to be typically shallow (>1.0 m) but with pockets of deeper peat, particularly in the central part of the Site, along the western boundary. It is considered that the peat depths collected, and interpolations derived from these data, are representative of the Site and have adequately informed the layout of the Proposed Development.

1.3.3 The peat excavation and reuse volumes included in this outline PMP are intended as an initial indication. The total peat volumes are based on a series of design assumptions and estimates for the Proposed Development layout and peat depth sample data interpolated across discrete areas of the Site. Such parameters can still vary over a small scale and therefore local topographic changes in the geological profile may impact the total accuracy of the volume calculations.

1.3.4 The PMP is a 'live' document and would be developed into a final PMP post-consent and in advance of construction commencing, when the contractor has been appointed. As part of this process it is proposed that further peat depth probing and coring would be undertaken at infrastructure locations, particularly wind turbine locations, post-consent and during pre-construction ground investigation surveys. This additional data would be used to aid micrositing of wind turbines away from any pockets of deeper peat into the shallowest areas, thereby minimising impacts on peatland within the micrositing tolerances, and to gather further information on the characteristics of the peat deposits present. A finalised post-consent layout would be completed once detailed ground investigations have been undertaken and before construction works commence. This would demonstrate how any newly collected information has been used to inform the proposed layout and minimise impacts on features such as deep peat.

1.4 Peatland Condition

1.4.1 Two peat depth probing surveys were undertaken at the Site, with a combined total of 1,889 peat probes taken. This comprised 843 peat depth probes during the Phase 1 survey, as part of a low resolution survey across the developable area of the Site, and a further 1,046 probes during Phase 2 survey based on a more mature development layout. The results of the surveys were used to inform the design layout of the Proposed Development.

1.4.2 Most of the developable area of the Site has either no peat present or has a shallow depth of peat present (~88% <0.5 m in depth). These areas of shallow peat can be considered as organo-mineral soils. These are further summarised as follows:

- 614 no. samples (32.5%) located on land with no peat/ absent;
- 1,049 no. samples (55.5%) located on land with less than or equal to 0.55 m depth of peat or organo-mineral soil;
- 99 no. samples (5.2%) fell on land with between 0.51 m and 1.0 m depth of peat; and
- 127 no. samples (6.7%) located on land with more than 1.0 m depth of peat.

1.4.3 The maximum depth of peat recorded at the Site was 5.2 m, located in the central part of the Site, south of Craig Watch and west of Brown Hill during the Phase 1 survey. The maximum depth of peat recorded during the Phase 2 peat probe survey was 3.0 m, located to the north of Turbine 8. The mean peat depth recorded was 0.31 m.

1.4.4 The peat depth data was interpolated in GIS using an inverse distance weighting approach, the results of which are shown on Figure 2.3.1 in Technical Appendix 2.3.

1.4.5 Overall, the peat sampled across the developable area of the Site were relatively shallow. Deeper areas of peat were noted, particularly along the western part of the central area of the Site. The peat was found to be generally dry/ semi-dry and in a state of weak to strong decomposition. This is likely to be as a result of the presence of coniferous plantation and extensive artificial drainage across the Site, which has resulted in modification to the integrity and composition of the peat and carbon rich soils.

[1] Scottish Renewables and SEPA, (2012). Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste.

[2] SEPA, (2011).Restoration Techniques Using Peat Spoil from Construction Works.

1.4.6 The Proposed Development's infrastructure has been located away from these deeper peat locations where practicable, taking into account other environmental and technical constraints, or microsited to minimise potentially significant adverse effects. No turbines are located on deep peat.

1.4.7 Further details of the peatland condition and findings from the peat surveys are included in the Peat Depth Survey Report (Technical Appendix 2.3).

1.5 Estimated Peat Balance

1.5.1 The volume of peat excavated and to be reinstated has been estimated based on the following data and assumptions:

- review of interpolated peat model generated using Ordnance Survey 5 m Digital Terrain Model;
- peat depth survey data from probing during the Phase 1 and 2 surveys;
- excavations would take place only within the footprint of the Proposed Development;
- peat would shrink on replacement due to some inevitable dewatering during handling and compaction at placement;
- currently assumed that there is potential to use floating access tracks dependent on the findings of ground investigations for specific sections of track where peat depth is >1.0 m – consideration of use of floating construction is likely to be limited to the section of track located to the west of Turbine 7 (~226 m total);
- assumed that ditch backfilling and reinstatement of historic peat cutting, ploughed furrow and destumped areas could be subject to backfilling with peat, along with improvement to other areas of degraded or existing peatland as part of habitat management and restoration (as laid out in the outline habitat management plan, Technical Appendix 7.5). These will be confirmed and developed further as part of the detailed PMP and habitat management plans prior to construction;
- assumed that temporary peat excavated from temporary infrastructure such as the construction compound and cable runs could be reinstated, and therefore not considered as part of the permanent excavation volumes;
- a borrow pit is proposed as part of the Proposed Development; and
- a proportion of acrotelm peat would become unsuitable for reuse as the top layer due to unavoidable damage to vegetation during the excavations.

1.5.2 Specific design assumptions used to estimate the peat volumes to be excavated and reinstated are:

- the area for construction of the wind turbine foundations has been estimated to be a maximum diameter excavation to allow for an excavated working area around the concrete foundation (refer to Chapter 2: Development Description). A concrete foundation slab of approximately 22 m diameter would sit on the underlying rock or suitable substratum with a founding depth of between 3 m to 5 m. With regard to backfilling at these foundations, it has been assumed that an area of the 'compacted backfill between foundation and excavation face', would partially comprise peat. Peat would not be used to backfill the excavation void over the 22 m diameter plan footprint of the foundation due to its potential low strength; instead, rockfill, sands, or gravel would be required to backfill, but could be used outside of this area. The area of potential peat backfill equates to 540 m² per wind turbine. As above, the founding depth would be up to 5.0 m, however for the majority of the Site it has been assumed a depth of up to 2.0 m can be used as an approximation to backfill excavations to ground level;
- it has been assumed a restoration area of 650 m² per turbine could be used for surface reinstatement of peat around each turbine (based on a thickness of 0.2 m);
- a crane hardstanding would be required at each wind turbine location, these would be maintained during the operational phase of the Proposed Development. It has been assumed that one length and one width of each hardstanding would be available for reinstatement during construction, with verges 3 m in width;
- a 50 m x 170 m substation compound would be required, and it is assumed that two lengths and one width would be available for verge reinstatement, with verges 3 m in width; and
- new access tracks would be flanked by low angle landscaped verges that would seek to provide visual continuity and topographical tie-in between the access tracks and the surrounding peatland. The verges used for finishing and landscaping of the new access tracks would be extended to 2.5 m either side of the full track width (e.g. running width and track shoulders).

1.5.3 Table 2.4.1 provides estimates of the volumetric peat balance for the Proposed Development. These volumes would be subject to review and updated following ground investigation, detailed design and micrositing as part of the post-consent process, prior to construction.

Table 2.4.1: Estimated Peat Volume to be Excavated

Element	Estimated Peat Volume to be Excavated (m³)
Turbine 1 – foundation and excavation area	512
Turbine 2 – foundation and excavation area	512
Turbine 3 – foundation and excavation area	512
Turbine 4 – foundation and excavation area	512
Turbine 5 – foundation and excavation area	512
Turbine 6 – foundation and excavation area	512
Turbine 7 – foundation and excavation area	1,024
Turbine 8 – foundation and excavation area	512
Turbine 9 – foundation and excavation area	512
Turbine 10 – foundation and excavation area	512
Turbine 11 – foundation and excavation area	512
New cut tracks, emergency access tracks, turbine hardstandings and met mast	23,796.7
New floating tracks	0
Permanent substation compound	4,250
Borrow pit search area (1no)	900
TOTAL	**35,090.7**

1.5.4 Table 2.4.2 provides an estimate of the potential reinstatement opportunities for the Proposed Development.

Table 2.4.2: Estimated Peat Volume to be Reinstated

Element	Area to be Restored (m²)	Average Depth of Restoration Area (m)	Total Reinstatement (m³)
Turbine foundations - surface	7,150	0.20	1,430
Turbine foundations - backfill	5,940	2.0	11,880
Crane and met mast hardstanding verges	1,020 + 150	0.5	735
Permanent substation compound verges	1,170	0.5	585
Access track verges	39,900	0.5	19,950
Borrow pit restoration	4,500	0.6	2,250

Table 2.4.2: Estimated Peat Volume to be Reinstated			
Element	Area to be Restored (m^2)	Average Depth of Restoration Area (m)	Total Reinstatement (m^3)
Ditch backfilling/ habitat management and restoration	0	1.0	0
TOTAL			**37,280**

1.5.5 On this basis, there is potential that the peat excavated as part of the Proposed Development can be reused on-site. There is potential that some of the peat excavated could be used for habitat and peatland restoration at the Site, rather than reused for backfilling excavation and borrow pit restoration.

1.6 Classification of Peat

1.6.1 Peat was characterised as part of the Phase 2 peat survey which considered the physical properties of peat cores taken across the Site. The key measures of peat condition, which are important to establishing the appropriate type of reuse, are noted in Table 2.4.3. Overall, the sample results suggest that the acrotelm layer is variable in depth and it is recommended that the upper 0.5 m should be reused as part of the reinstatement programme, where this depth of material is available. Excavation of 0.5 m ensures that the acrotelm remains as intact as possible and captures much of the underlying seed bank material which would aid vegetation regeneration. With regards to the catotelm material within the proposed developable area of the Site, the results indicate that all material is mostly intermediate and fibrous in nature.

Table 2.4.3: Peat Classification	
Peat Type	Key Measure and Survey Summary - Survey Results
Acrotelm	Depth – the depth of acrotelm ranged from 0 m to 3.0 m, with a mean depth of 0.27 m. Due to the difficulties of excavating a thin layer of acrotelm without causing significant damage to it, it is recommended that 0.5 m of surface peat is excavated (where possible) for reuse as acrotelm material. On this basis, it is estimated there is 32,864 m³ of acrotelmic peat to be excavated as part of the Proposed Development.
Acrotelm/ catotelm	Depth – it is estimated that the depth of catotelmic peat to be excavated as part of the Proposed Development is 302.7 m³.
	Degree of humification – the sub-samples were mostly intermediate or fibrous.
	Fibrous content – the majority of the sub-samples were assessed as having moderate fine fibre content (F2) and having low coarse fibre content (R1).
	Water content – the results indicate that all the sub-samples were noted to be dry or semi-dry (B1 to B2). No sub-samples were recorded as wet.
	Von Post – the results indicate that all of the sub-samples were assessed as having weak to strong rates of decomposition (between H4 and H7). This is likely to be as a result of the presence of commercial forestry at the Site, and the subsequent modified nature of the soils present.

1.7 Requirements for the Detailed Peat Management Plan

1.7.1 The contractor would be required to update the outline PMP prior to the construction phase commencing, based on additional information such as the results of ground investigation and detailed design. As part of this update, the contractor would be required to ensure excavated peat and other soils are reused on-site, subject to the conditions and methods of reinstatement described in the outline PMP. The final PMP would detail the following:

- a construction timetable and highlight any seasonal considerations;
- comply with SEPA construction site licence, as required;
- include measures to be put in place to deal with weather related events (flash floods, peat slide, snow melt, dust);
- appropriate use of track and road material, and other hard-standing material to minimise pollution;
- detail measures to enable sediment management in emergency situations, to cope with high rainfall and runoff;
- detail how construction would be scheduled around key Site constraints (such as the breeding or migration seasons for bird and fish). Where scheduling is not practical it would state what other mitigation could be put in place; and
- detail how construction would be scheduled to benefit Site restoration.

1.8 Project Phasing

1.8.1 There are three distinct project phases, construction, operation, and decommissioning. Key activities for each phase are described in the following sections.

Construction

1.8.2 The key activities to be undertaken during the construction phase include:

- prepare the final PMP referring to the detailed design and additional Site information (such as ground investigation);
- set-out peat stripping areas;
- set-out temporary peat and no peat soil storage areas;
- set-out receptor areas for direct translocation of peat as per detailed peat translocation plan;
- strip peat in pre-defined phases;
- put peat and other soils into temporary storage;
- translocate peat where pre-planned;
- reinstate the peat and other soils that have been in temporary storage; and
- monitor vegetation and stability of reinstated soil around the infrastructure, restored peatland areas, and soils to be stored for the duration of the construction period.

Operation

1.8.3 During this phase no peat excavation is anticipated.

Decommissioning

1.8.4 The peat management during decommissioning would follow the same principles as during the construction. It is not expected that disturbance of adjacent peat would be required upon the removal of turbine hardstandings. Restoration of turbine hardstandings would be restored using suitable soils or peat available, but would be confirmed as part of the wider decommissioning restoration plan.

1.8.5 The main mitigation measure relating to decommissioning would be blocking of any artificial ditches (that were created during construction and were required during the operation of the Proposed Development) to facilitate rewetting of adjacent peatland. It is likely that the main tracks would remain in place to facilitate ongoing access to the Site, depending on the arrangements with the landowner and other users of the Site.

1.9 Monitoring and Record Keeping

1.9.1 An Ecological Clerk of Works (ECoW) would be appointed by the contractor prior to commencement of the construction phase. They would be responsible for monitoring compliance against the final PMP and other relevant documents such as the final CEMP. They would also be responsible for ensuring the legislative requirements would be complied with.

1.9.2 The contractor and the ECoW would be responsible for maintaining clear records during the construction phase such as depths and types of peat excavated, plans showing peat storage areas and locations of reinstated peat.

1.10 Peat and Mineral Soil Handling Methods

1.10.1 This section provides guidance to help the contractor in both planning and executing the construction works at the Proposed Development. Working in peat cannot be avoided because the Site is underlain by peat of variable depth and thickness (refer to Figure 2.3.1 in Technical Appendix 2.3). Peat would be excavated and could be stored temporarily in an appropriate location as set out previously where temporary storage is necessary. Careful handling of the peat would also be required to ensure its suitability for reuse.

1.10.2 The contractor would provide a detailed method statement for works in peat habitats, including but not limited to:

- how to minimise the area of impact;
- how to avoid areas of higher quality bog vegetation (with the assistance of the ECoW);
- means of access to areas of work and to areas where peat would be reused;
- methods of peat removal;
- managing water in the peat and pollution prevention;
- where to avoid unnecessary intrusive work wherever possible;
- drainage measures and design and use of appropriate techniques to maintain local hydrology; and
- plans for the deposition of peat on Site to be agreed with the Applicant and the ECoW.

1.10.3 It would be necessary for the final PMP to detail the methods and timing involved in handling, storing and using peat for reinstatement, all of which would be dependent on the equipment adopted for the construction activities. The final method statement for this should be based on the following principles:

- the surface layer of peat and vegetation (acrotelm) would be stripped separately from the catotelmic peat. Where possible this would involve an excavation depth of 0.5 m and the creation of turves;
- the turves should be as large as practicably possible to minimise desiccation effects during storage;
- the turves should be kept wet but not saturated, and not allowed to dry out when in temporary storage;
- contamination of excavated peat with other substrate materials (e.g. gravels, clays or silts) should be avoided and these materials stored separately where excavated;
- acrotelmic material would be stored separately from catotelmic material even if some of this layer appears to be lacking vegetation, since it may contain a seedbank that is useful for re-establishing vegetation;
- any risk of peat slide must be considered by a suitably qualified engineer and where risk is identified protective measures developed and agreed with the Applicant before further construction works take place;
- careful handling would be essential to retain any existing structure and integrity of the excavated materials and thereby maximise the potential for excavated material to be reused;
- plan all works to reduce the need for double handling the peat;
- movement of excavated turves and peat should be kept to a minimum and it is preferable to transport peat intended for translocation to its final destination at the time of excavation;
- less humified catotelmic peat (consolidated peat), which maintains its structure upon excavation, should be kept separate from any highly humified amorphous peat;
- consider the timing of excavation activities to avoid very wet weather periods in order to reduce the risk of peat becoming wet and unconsolidated, thereby reducing pollution or peat slide risk;
- acrotelmic material would be replaced as intact as possible once construction is complete; and
- to minimise handling and transportation of peat, acrotelmic and catotelmic materials would be replaced, as far as is reasonably practicable, in the location from which it was removed. Acrotelmic material must be placed on the surface.

1.10.4 The handling of peat should be monitored by the ECoW and the Applicant to ensure the above principles are adopted and implemented during construction of the Proposed Development.

Minimising Damage to Existing Vegetation

1.10.5 To minimise damage to the existing vegetation, construction plant required for reinstatement and landscaping works would be positioned on constructed access tracks, hardstanding areas or existing disturbed areas wherever possible. Areas to be excavated would be clearly marked on the plans and then on the ground to ensure that no work is undertaken outside the construction footprint.

1.10.6 Tracked, low ground-pressure, long reach excavators would be used for peat handling and reinstatement works. A low ground-pressure excavator would be used if the extent of the long reach arm is insufficient. Other machinery, such as tippers, would also be tracked and low-ground pressure type when required to travel on soft ground and the use of ground protection mats could be required.

1.10.7 Reinstatement of vegetation would be focused on natural regeneration utilising peat vegetated turves (acrotelm). In the unlikely event that the quantity of excavated acrotelm turves is not sufficient, a nurse moorland grass seed mix would be used. The species mixture would be specified in the final PMP and could include lowland species to encourage early establishment.

Planning of Peat Reinstatement

1.10.8 Peat reinstatement would be undertaken using methods to minimise double handling of peat and the distances between source and receptor areas. Peat translocation, reinstatement and restoration would be carried out concurrently with other elements of the Proposed Development's construction. To achieve this, a detailed peat translocation plan would be included in the final PMP. The final PMP would include peat management recommendations as per SEPA guidance[1].

1.10.9 When peat is disturbed or translocated artificially it is prone to drying because fragmentation lets the water drain away and prevents it from accumulating. To create conditions suitable for wet bog restoration, the reinstated peat needs to be kept wet, otherwise, the vegetation would dry out, the peat would shrink and crack, and would ultimately be eroded by water and wind, which would make the restoration unsuccessful and is likely to create problems such as peat floods, water pollution, and peat landslides.

1.10.10 The main principle of keeping the water close to the reinstated surface (maintenance of high-water table) is to use natural and artificial enclosures to slow down the horizontal flow of water. For the enclosure to work, the peat surface needs to be flush with or only slightly (<0.3 m) above the level of adjacent land (to allow for settlement). If the level of translocated peat is substantially higher, then it would be at high risk of drying out and being easily eroded as the water would not be held effectively by the peat alone, it would naturally flow sideways.

Temporary Peat Storage

1.10.11 It is anticipated that during construction, on most occasions, peat and peaty soil would only be handled once and would be placed at its end use locations. However, during construction a degree of temporary peat storage would be required before the excavated material could be re-used in restoration and placed in its end use location.

1.10.12 It would be necessary for the final PMP to detail the methods and timing involved in temporary storage, where this is required. It is likely that a degree of temporary peat storage would be required, for instance in association with stripping areas of any area used for temporary land take; this material would then be used in the subsequent restoration of this temporary construction area.

1.10.13 The final method statement for this temporary storage of peat would be based on the following guiding principles:

- temporary storage of peat should be minimised. Where required it should be temporarily stored in stockpiles/ bunds adjacent to and surrounding each infrastructure Site;
- acrotelm, catotelm, and any clay/ glacial till or other substrata should be stored separately and appropriately to ensure no mixing of materials and to prevent cross-contamination;
- suitable storage areas should be sited in areas with lower ecological value, low stability risk areas and at a minimum distance of 50 m from watercourses. Identified suitable areas would form part of the final PMP and would be agreed in advance with the ECoW;
- peat turves should be stored in wet conditions where possible (e.g. within waterlogged former excavations) or irrigated in order to prevent desiccation;
- larger stockpiles are preferable to numerous small stockpiles, which minimises exposure to sun and wind, which could lead to desiccation. Stockpiles would not exceed 2 m in height and would be sited with due consideration for slope stability. Benching of stored peat could be necessary to provide stability;
- stores of non-turf, i.e., catotelm, should be bladed off to reduce surface area and desiccation of the stored peat;
- stores of peat, particularly catotelmic material, should be inspected regularly (at least weekly) and following heavy rainfall or thaw conditions to check for any evidence of movement, tension cracks or instability in the stored peat. If there is any evidence of instability, appropriate remedial measures should be taken as necessary on the advice from a suitably qualified engineer;
- in dry weather periods, consideration should be given to watering stored turves and peat to prevent drying out, wastage and erosion;
- pollution prevention measures should be installed around peat storage areas;
- reinstatement would, in all instances, be undertaken at the earliest opportunity to minimise storage of turves and other materials;
- timing the construction work, as much as possible, to avoid periods when peat materials are likely to be wetter; and
- where practical, transportation of peat on-site, from excavation to temporary storage and restoration locations, should be minimised.

Reinstatement of Peat

Access Tracks

1.10.14 The reinstatement would be carried out progressively with peat excavated from other areas placed directly on the sides of the tracks. This would take place everywhere where the cut tracks pass through peat. The surplus peat, not reinstated along the verges, would be either directly translocated to the receptor areas or stored temporarily in designated areas.

1.10.15 The construction of the track involves the excavation of the acrotelm and catotelm, or top, organic layer of peaty soils, and some mineral subsoil. These would be separated on excavation, ensuring no mixing of the different peat layers, and different soil types. Once all the soil has been excavated and the higher bearing underlying subsoil has been reached, good quality aggregate should then be placed. Up to 0.5 m of acrotelm would be used to reinstate the track verges.

1.10.16 Following construction of the section of access track, turves would be replaced along the road edges to allow quicker re-vegetation and soften visual landscaping of the road edges. Acrotelm turves would be used for this purpose, this would be done in a manner to ensure works tie in with the surrounding topography, landscape and ground conditions, and only where this is required and would not result in adverse environmental effects.

Turbine Foundations and Hardstanding

1.10.17 Once the wind turbine foundation has been constructed, depending on the target depth of reinstated peat, some catotelmic peat could be replaced around the turbine base excavations (subject to detailed foundation construction requirements), and re-turfed with acrotelm. Peat would be placed into any areas disturbed by the construction activities, around the crane hardstandings, rotor assembly hardstandings and other areas used in the construction phase. Other hardstanding areas, such as around the substation compound would also include areas for re-use of acrotelm.

Temporary Compounds and Cable Runs

1.10.18 The temporary construction compounds would be restored following removal of the stone hardstanding. The peat would be reinstated to be flush with the adjacent ground. Similarly, cable runs would be reinstated using peat as excavated, to ensure that the soil horizons would be replaced as removed.

Borrow Pit Restoration

1.10.19 As part of the borrow pit restoration, it is assumed that a thickness of 0.6 m of peat can be reused provided that it presents no residual pollution risks or harm to human health (an increased thickness of peat can be used if located within a deeper thickness of peat). The excavated peat would need to be suitable for restoration purposes to achieve the establishment of peatland habitats and a functional hydrological regime would need to be established in the borrow pit restoration to prevent desiccation of peat. This would include the reuse of both acrotelmic and catotelmic peat.

Ditch Backfilling and Habitat Restoration

1.10.20 Where possible, ditches and other cut areas, such as historic peat cut areas, should be considered for reinstatement. This would be explored further as part of the final PMP but it is assumed that there is potential to reinstate peat excavated in these areas. This would also include the consideration of other areas of the Site that could be used for the suitable reuse of peat as part of habitat and peatland improvements.

1.10.21 The ECoW would monitor back-filling works to check compliance with relevant documents (such as PMP and CEMP). The main parameters for ditch backfilling that would be required are:

- areas with relatively dry peat would be chosen;
- works would be carried out during a period of dry weather;
- specialist low-ground pressure tracked dumpers would be used;
- bog mats would be used where required;
- both source and receptor areas would have good vegetation cover;
- site supervision by the ECoW would enforce changing routes to avoid damage to vegetation;
- acrotelm excavated from the source location would be kept vegetated side up; and
- excavated catotelm would be used in ditch-backfilling shall be of H6-H8 level of decomposition.

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TA 2.5: Peat Landslide Hazard and Risk Assessment

Technical Appendix 2.5: Peat Landslide Hazard and Risk Assessment

1.1 Introduction

1.1.1 Ramboll was commissioned by the Applicant to undertake a Peat Landslide Hazard and Risk Assessment (PLHRA) for the Proposed Development and is a Technical Appendix to the EIAR.

1.1.2 The PLHRA has been prepared in accordance with appropriate guidance and best practice, namely the Scottish Government Peat Landslide Hazard and Risk Assessment Best Practice Guide (2017)[1]. This Technical Appendix assesses the potential risk of peat slide at the Site as well as providing a precis of the geological and hydrological conditions. The Technical Appendix also outlines suitable mitigation measures, where required, to reduce risks identified. A full description of the Proposed Development is provided in Chapter 2: Development Description but in summary comprises:

- Eleven (11) wind turbines, each up to a maximum tip height of 200 m;
- permanent foundations supporting each wind turbine;
- associated crane hardstanding at each turbine location;
- a main Site entrance for use during construction and operation, designed to accommodate abnormal indivisible loads required for turbine component delivery, together with a wider section of track near to the main Site entrance to provide parking for component deliveries;
- a series of upgraded and new on-site access tracks with associated watercourse crossings, turning heads and passing places;
- underground cable arrays within the Site connecting the turbines to the on-site substation;
- substation compound, a control building (if required) and energy storage systems (if required). In terms of appearance, the system would be comparable to the on-site substation. Any storage would fall within the substation area;
- temporary construction compounds and laydown areas;
- a permanent anemometer mast including associated foundations and hardstanding;
- borrow pit for infrastructure foundation and track construction rock material; and
- associated engineering operations and ancillary works

1.1.3 This Technical Appendix represents the findings and opinions of experienced geotechnical and environmental consultants based upon the information obtained from a variety of sources as detailed. Ramboll believes the information obtained from third parties is reliable but does not guarantee its authenticity, but professional judgement has been used in its interpretation

1.1.4 This Technical Appendix is supported by the following:

- Figure 2.5.1: Elevation;
- Figure 2.5.2: Slope Angle;
- Figure 2.5.3a and b: Solid Geology;
- Figure 2.5.4: Geomorphology and Hydrology;
- Figure 2.5.5: Peat Depth Survey and Interpolated Peat Depths;
- Figure 2.5.6: Factor of Safety;
- Figures 2.5.7a-h: Contributory Factors; and
- Figure 2.5.8: Peat Slide Likelihood.

Objectives of the Study and Scope

1.1.5 The objectives of the PLHRA are to:

- undertake a desk top review of available geological, habitat, hydrogeological and topographical information;
- 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
- provide recommendations for further work or specific construction methodologies to suit the ground conditions to mitigate against any increased risk of potential peat instability.

1.1.6 The scope of the PLHRA is as follows:

- characterise the peatland geomorphology and identify any areas of historic instability or areas of potential future instability due to contributary factors.;
- determine the likelihood of a future of a potential peat landslide under natural conditions and in association with construction activities associated with of the Proposed Development of 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, and quantify the associated risks; and
- provide appropriate mitigation and control measures to reduce the risks to inform the construction the Proposed Development .

1.1.7 The PLHRA reporting has been written in accordance with the Scottish Government's Best Practice Guidance[1], noting that the guidance states reporting 'should not be taken as prescriptive or used as a substitute for the developer's [consultant's] preferred methodology'.

1.2 Desk Study

Site Location and Setting

1.2.1 The Site covers an area of approximately 1,074 hectares (ha) and is located on land approximately 8 km south east of Dufftown, Moray in Scotland. The Site straddles two local authority boundaries: Aberdeenshire Council (AC) and Moray Council (MC). Much of the Site is dominated by semi-mature coniferous plantation woodland, with some underlying marshy grassland and wet heath. Open areas of blanket bog and dry modified bog are located in the southwestern portion of the Site and around the slopes of Craig Watch. A mosaic of wet and dry heath, acid, improved and marshy grassland is located along the south western and south eastern corners of the Site. NatureScot's revised National Programme of Landscape Character Assessment (2019)[2] identifies the Site as being primarily within the following Landscape Character Types (LCT): 32 Farmed and Wooded River Valleys; 292 Open Upland; and 294 Upland Valleys – Moray and Nairn.

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

[2] Based on SNH Landscape Character Assessment 2019, available at https://data.gov.uk/dataset/cce069c5-8a2b-4932-9fae-4f9023cd9d5b/snh-landscape-character-assessment-2019M

Topography

1.2.2 The site topography is generally moderately steep rising ground across the western extents of the Site rising from the west at elevations of between 320 m to 501 m Above Ordnance Datum (AOD) at the summit of Garbet Hill. Ground also rises sharply across the northern Site extents from the northern boundary with the Chapel Burn watercourse to the summit of the Craig Watch Hill formation between elevations of 350 to 448 mAOD. Moderate rising ground is also located to the east of Site around Brown Hill (440 mAOD). The central areas of the Site from the eastern slopes of Garbet Hill to the area known as White Knaps is represented by moderately undulating ground. Topography elevations are shown on Figure 2.5.1.

1.2.3 Slope angles at the Site, as shown on Figure 2.5.2, are generally shallow (<5°) across the central areas and summits of the hill formations across the Site. Western slopes of Garbet Hill show areas of between 10° and >20° slope angles are present. Northern areas of the Site show slope angles are generally between 10° and 15° to the far north which moderate to between 5° and 10°. Slope angles within eastern areas of the Site are predominantly between 2° and 10°.

Geology

1.2.4 The 1:50,000 scale geological mapping available from the British Geological Survey (BGS)[3] shows the majority of the Site to be underlain by Neoproterozoic era, Pelite and Semipelite. Metamorphic Bedrock formed approximately 541 to 1000 million years ago from the Blair Atholl Subgroup. The bedrock is noted to be frequently interbedded with limestone in areas. The underlying bedrock of Garbet Hill and Craig Watch Hill formations is shown as Kymah Quartzite Formation metamorphic bedrock from the Islay Subgroup. Igneous intrusion has occurred to the northwest and eastern boundaries of the Site within the pelite formation rocks by Ordovician aged metagabbro from the Ernan-glass Metabasic Swarm and similar aged Serpentines from the Succoth-brown Hill Type Ultramafic Intrusion. BGS is shown on Figures 2.5.3a and b.

1.2.5 The superficial geology of the Site predominantly comprises Quaternary aged, Devensian, Till – Diamicton. Alluvial deposits, comprising River Terrace sand, silt, clay and gravels, bound the Site to the south east and west and are associated with the Findouran Burn and Burn treble watercourses.

1.2.6 Peat deposits are shown to be predominantly present within forest area to the north of the Site.

1.2.7 Areas of the Site, predominantly surrounding hill formations, are mapped as having no superficial deposits present which could imply that rockhead is relatively shallow in these areas.

1.2.8 The Scottish Natural Heritage (NatureScot) carbon rich soils, deep peat and priority habitat[4] shows the areas to the north of Garbet Hill and bounding the forestry to the south along Priests Well Spring as being Class 1 or Class 2 soils, both defined as nationally important carbon-rich soils, deep peat and priority peatland habitat. Forestry areas to the north and west of the Site are shown to be Class 5 and Class 3 soils respectively. These soil types are defined as where the dominant vegetation cover is not a priority peatland habitat.

Hydrogeology

1.2.9 The BGS 1:625,000 scale hydrogeology mapping defines the metamorphic rock formations underlying the Proposed Development area as impermeable rock. Any groundwater flow within the bedrock would be limited to the weathered zone or secondary fractures.

1.2.10 It is likely that the key aquifers within the Site would be limited to superficial deposits and the weathered bedrock zone.

Surface Water Features

1.2.11 There are a number of watercourses and small drains on the Site, including the Green Burn/ Burn of Findouran, the Burn of Succoth, the Burn of Guestloan, Linn Burn, Tammie's Burn, Chapel Burn and Keelholes Stripes, as well as further unnamed watercourses. These watercourses and the delineation of sub-catchments of watercourses on the Site are shown in Figure 2.5.4. All areas on which development associated with the Proposed Development could take place are within the catchment of the River Deveron.

1.2.12 Land in the south west of the Site drains in a westerly direction via Green Burn/ Burn of Findouran and further unnamed streams and drains to Charach Water (also referred to as Burn Treble), and on to the River Deveron.

1.2.13 The north east of the Site (to the north of the watershed running in a north easterly direction between Garbet Hill and Craig Watch) drains to tributaries of the Chapel Burn and Tammie's Burn, which both flow from the Site in a north easterly direction and discharge to the River Deveron. Land to the south east of this watershed drains in a south easterly direction via the Burn of Succoth, the Burn of Guestloan and Linn Burn to the River Deveron.

1.2.14 A very small area close to the central northern boundary of Site is in connection to Keelholes Stripe which flows on to Markie Water which in turn discharges to the River Deveron. No development is proposed on areas of the Site within the catchment of Keelholes Stripe.

1.2.15 An area in the north west of the Site drains to Dry Burn and the River Fiddich, no development is proposed on areas of the Site within the catchment of the River Fiddich and infrastructure associated with the Proposed Development is separated from the River Fiddich catchment by a distinct watershed that runs from Meikle Balloch Hill to Little Balloch Hill.

Land Use

1.2.16 Land to the north of the Site is given over to plantation forestry which comprises mature woodland. Although managed very little has been subjected to recent felling activities.

1.2.17 Forestry to the west of the Site is a mixture of mature and secondary plantation. Moorland around Garbet Hill and Craig Watch Hill have been managed for grouse and game shooting. Farmland to the east and southwest of the Site is predominantly utilised for cattle and sheep grazing.

1.2.18 During the Site walkover surveys conducted in March and July 2021, isolated areas to the east of Craig Watch Hill were noted to have undergone historical peat cutting.

Geomorphology

Peat Geomorphology

1.2.19 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 in Figure 2.5.4, were subsequently verified during Site walkover and survey undertaken by an experienced peatland geomorphologist and hydrologist in March and July 2021.

1.2.20 The geomorphological features recorded are shown on Figure 2.5.4. The presence, characteristics and distribution of peatland geomorphological features have been defined to understand the hydrological function of the peatland, with particular reference to the balance of erosion and peat accumulation (or condition), and the sensitivity of peatland to potential land-use changes.

[3] British Geological Society https://mapapps.bgs.ac.uk/geologyofbritain/home.html

[4] Scottish Natural Heritage. (2016). Carbon and Peatland 2016 map (http://map.environment.gov.scot/soil_maps/)

1.2.21 As noted above, areas of the Site have historically been intensively managed though commercial forestry plantation, with artificial drainage measures used. In some areas diffuse natural drainage systems were also noted. Within the commercial plantation and forestry areas it was noted that the acrotelmic peat was highly modified as a result of planting and felling activities.

1.2.22 Significant peat deposits were recorded within the forestry to the west of Brown Hill. This was bounded along the south western extent of the peatland by spring features. A variety of haggs and grough formations were noted along this boundary with visible areas of instability along peat exposures.

1.2.23 Similar notable peat accumulations were also noted in the Priests Spring area and summit areas of Garbet Hill and Craig Watch Hill. Here the peat has undergone basal erosion from surface water runoff or where flush/ spring features were recorded. This action has resulted in a series of historic peat slides leaving the formation of steep peat exposures, haggs and groughs located around these areas. Peat pipe features were also recorded within the northern forestry area.

Peat Depth and Character

1.2.24 Two peat depth probing surveys were undertaken at the Site, with a combined total of 1,889 peat probes taken. This comprised 843 peat depth probes during the Phase 1 survey, as part of a low resolution survey across the developable area of the Site, and a further 1,046 probes during Phase 2 survey based on a more mature development layout. The results of the survey were used to inform the design layout of the Proposed Development.

1.2.25 Most of the developable area of the Site has either no peat present or has a shallow depth of peat present (~88% <0.5 m in depth). These areas of shallow peat can be considered as organo-mineral soils. These are further summarised as follows:

- 614 no. samples (32.5%) located on land with no peat/ absent;
- 1,049 no. samples (55.5%) located on land with less than or equal to 50 cm depth of peat or organo-mineral soil;
- 99 no. samples (5.2%) fell on land with between 51 cm and 100 cm depth of peat; and
- 127 no. samples (6.7%) located on land with more than 100 cm depth of peat.

1.2.26 The maximum depth of peat recorded at the Site was 5.2 m, located in the central part of the Site to the west of Brown Hill (along the western boundary of the Site), as part of the Phase 1 survey. The maximum depth of peat recorded during the Phase 2 peat probe survey was 3.0 m, located to the north of Turbine 8. The mean peat depth recorded was 0.31 m.

1.2.27 The peat depth data was interpolated in GIS using an inverse distance weighting approach, the results of which are shown on Figure 2.3.1: Technical Appendix 2.3.

1.2.28 Overall, the peats sampled across the developable area of the Site were relatively shallow, with deeper areas of peat noted in the central area of the Site, along the western site boundary, west of Brown Hill.

1.2.29 The peat was found to be generally dry/ semi-dry and in a state of weak to strong decomposition. This is likely to be as a result of the presence of coniferous plantation across the Site, which has resulted in modification to the integrity and composition of the peat and carbon rich soils.

1.2.30 The Proposed Development's infrastructure has been located away from these deeper peat locations where practicable, taking into account other environmental and technical constraints, or microsited to minimise potentially significant adverse effects.

1.2.31 Further details of the peatland condition and findings from the peat surveys are included in the Peat Depth Survey Report (Technical Appendix 2.3).

1.3 Peat Instability

Types of Peat Instability

1.3.1 Peat instability can be categorised as either 'minor instability' or 'major instability', and recorded during site walkover and field observations and via desk top review of Site imagery:

- Minor instability – localised and small scale features including peat pipes, tension cracks, slumping etc. Wear surface erosion of the peat has occurred may have caused undercutting of slopes so haggs and groughs may identify areas of peat; and
- Major instability - comprising various forms of peat landslide , ranging from collapse and outflow of peat filled drainage lines/ gullies (occupying a few tens of cubic metres), to medium scale peaty-debris slides in organic soils (tens to hundreds of cubic metres) to large scale peat slides and bog bursts (thousands of cubic metres).

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

- Peat slide - the failure of the peat to its full depth leading to sliding of surface vegetation together with the underlying peat stratum exposing the substate geology;
- Bog Bursts or Bog Flows – the emergence of a fluid form of well humified, amorphous peat from the surface, followed by the settling of the residual peat; and
- Bog Slide – an intermediate form of instability where failure occurs on a surface within the peat mass resulting in surface vegetation being carried by the movement of a mass of liquid peat beneath.

1.3.3 Peat slides generally occur within peat deposits less than 1.5 m deep and on moderately steep slope angles, typically ranging between 5° to 15°.

1.3.4 Bog bursts generally occur within areas of deeper peat (Up to 10 m depth) with shallower slope angles, typically 2° to 5°. Bog bursts are rare and have only previously been reported in Scotland within the Western Isles[5].

Peat Slide Contributing Factors

1.3.5 Peat instability is generally caused by a combination of factors which can be summarised as either triggering or preconditioning factors. Triggering factors usually have an immediate effect, whereas preconditioning factors can cause instability over much longer time periods.

1.3.6 Examples of preconditioning factors include:

- impermeable substrate beneath peatland causing saturation;
- impeded drainage caused by a peat layer overlying an impervious clay or mineral base (hydrological discontinuity);
- slope convexity causing basal outwash of peat;
- a convex slope or a slope with a break of slope at its head (concentration of subsurface flow);
- additional surface water drainage or supply, either via natural watercourses or man-made gully's or pipes;
- man-made transverse drainage ditches, or grips;
- loss of surface vegetation either from peat cutting or burning;
- increase in mass of peat either through heavy rainfall periods or increase in peat formation;
- tension cracks or changes in physical shear strength of peat formation;

[5] Bowes DR (1960) A bog-burst in the Isle of Lewis. Scottish Geographical Journal

- 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 content of peat.

1.3.7 Triggering factors are direct and short duration events. Examples of these include:

- intense rainfall or snowmelt;
- rapid ground accelerations from seismic events including blasting or earthquakes;
- undermining of peat through excavation;
- changes in drainage of peat slopes;
- 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
- excessive loading by either plant vehicle or construction of infrastructure.

1.3.8 Whilst some of the natural events such as excessive rainfall cannot be managed or mitigated, man-made or construction activities can be through considered design.

Assessing Peat Instability Methodology

1.3.9 This assessment considers both a limit equilibrium approach (or FoS) and a contributory factor-based approach.

1.3.10 Using a contributory based can identify site-specific areas of instability where additional mitigation measures may be required. A FoS based approach is a numeric calculation from assumed or measured geotechnical parameters which can be applied to site topography to determine areas of potential instability. Both methods follow SEPA best practice Guidance and follow the following concept:

Probability of Peat Landslide x Consequence of Peat Landslide = Risk

1.4 Peat Landslide Likelihood

Introduction

1.4.1 This section of the report details the landslide susceptibility and limit equilibrium approaches to inform the assessment of peat landslide likelihood. Determining likelihood is fundamental in the calculation of risk:

Risk = Probability of a Peat Landslide x Adverse Consequences

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

Limit Equilibrium Approach

1.4.3 Stability analysis has been undertaken using functionality within ArcGIS the infinite slope model to determine the FoS based on 25 m x 25 m cells across the proposed Site area. The limit equilibrium approach has been applied within areas where the peat thickness is >0.5 m. By targeting limited areas of a slope, the approach can examine potential instability where factors may differ and produce an accurate stability model.

1.4.4 The stability of a peat slope is assessed by calculating a Factor of Safety, F, 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/m³);
- γw is the unit weight of water (kN/m³);
- 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 (°).

1.4.5 Where the assessment indicates driving forces exceed the shear the FoS or F is <1, indicating instability. A FoS value of between 1 and 1.4 assumes marginal stability. Where values are calculated to be >1.4, the slopes are considered to be stable.

1.4.6 There are several uncertainties involved in applying geotechnical parameters to peat which are effected by the degree of humification of the peat, its water content and its organic composition. Therefore, to assist with this assessment, published values have been used to inform the stability analysis.

Data Inputs

1.4.7 As mentioned in the section above stability analysis has been undertaken using Arc GIS software and a 25 m x 25 m grid within areas of recorded peatland.

1.4.8 Table 2.5.1 shows the input parameters and assumptions for the stability analyses undertaken. As detailed ground investigation and geotechnical laboratory analysis have not been undertaken to determine shear strength of the peat deposits, published literature has been used to assign conservative values.

Table 2.5.1: Geotechnical Parameters for Slope Analysis

Parameter	Values	Rationale	Source
Effective Cohesion (c')	2, 5	Conservative cohesion values for humified peat based on literature review	5.5 - 6.1 - peat type not stated (Long, 2005)[6] 3, 4 - peat type not stated (Long, 2005)[6] 5 - basal peat (Warburton *et al*, 2003)[7] 8.74 - fibrous peat (Carling, 1986)[8] 4 - peat type not stated (Dykes and Kirk, 2001)[9] 7 – 12 - H8 peat (Huat *et al*, 2014)[10]
Bulk Unit Weight (γ)	10.5	Average conservative values taken from Bulk Density laboratory analysis.	Laboratory Analysis of Russian Auger samples
Effective Angle of Internal Friction (φ')	22	Credible conservative friction angle for humified peat based on literature review	40 – 65 - fibrous (Huat *et al*, 2014)[10] 50 – 60 - amorphous (Huat *et al*, 2014)[10] 36.6 - 43.5 - peat type not stated (Long, 2005)[6] 31 – 55 - Irish bog peat (Hebib, 2001)[11] 34 – 48 - fibrous sedge pear (Farrell & Hebib, 1998)[12] 32 – 58 - peat type not stated (Long, 2005)[6] 23 - basal peat (Warburton *et al*, 2003)[7]

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

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

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

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

[10] Huat *et al* (2014) Geotechnics of organic soils and peat

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

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

Table 2.5.1: Geotechnical Parameters for Slope Analysis

Parameter	Values	Rationale	Source
			21 - fibrous peat (Carling, 1986)[8]
Slope Angle from Horizontal (β)	Various	Mean slope angle per 25 m x 25 m grid cell	5 m DTM of Site taken from published LiDAR data
Peat Depth (z)	Various	Mean peat depth per 25 m x 25 m grid cell	Interpolated peat depth from peat probing surveys
Height of Water Table as a Proportion of Peat Depth (h)	1	Assumes peat mass is fully saturated	Assumed for analysis

Results

1.4.9 Figure 2.5.6 shows the results for drained analysis of the peat areas at the Site for the more conservative of the two parameter sets above (φ' of 22° and c' of 5 kPa). The results indicate that even with conservative parameters, factors of safety demonstrate stability across most of the Site (FoS >1.5). Areas of instability were recorded during the Site walkovers and the design layout of the scheme has been revised to locate the Proposed Development infrastructure away from these areas.

Landslide Susceptibility Contributing Factors Approach

1.4.10 The landslide susceptibility approach is based on the layering of contributory factors identify areas of potential instability. The assessment is limited to areas where peat is >0.5 m depth.

1.4.11 Eight contributory factors are considered in the analysis:

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

1.4.12 For each contributing factor, a series of numerical scores between 0 and 3 are assigned. The higher the score, the more each factor is considered detrimental to peat instability. Where a score of "0" has been determined, this indicated a neutral effect on slope stability.

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

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

Slope Angle (S)

1.4.14 Table 2.5.2 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 2.5.2: 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 rare due to low slope angles	2
≤2.0	Failure is very rarely associated with flat ground, neutral influence on stability	0

1.4.15 Figure 2.5.7b shows the distribution of slope angle scores across the Site. The results indicate that the slope angles across most of the hill formation areas of the Site are moderately steep or very steep (>5° or locally >20° respectively). Areas through the centre of the Site within the Brown Hill Forestry are generally shallow (<5°) but with locally steeper variations.

Peat Depth (P)

1.4.16 Table 2.5.3 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 2.5.5 and reflect the peat depth ranges most frequently associated with peat slides (Evans and Warburton, 2007)[13].

Table 2.5.3: 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

1.4.17 Figure 2.5.7a shows the distribution of peat depth scores across the Site. The western extents of the Site are predominantly covered by a limited thickness of peat <0.5 m depth with the exception of the summit of Garbet Hill where peat was recorded to a depth of 2.0 m. The Howeshalloch Moss area of the Site to the north has significant peat depth of up to 4.0 m depth which decreases rapidly once the gradient begins to increase to the south. The Howeshalloch Forest and northern Brown Hill forest area has predominantly shallow peat with isolated pockets of deep peat up to 2.0 m depth. The southern area of the Brown Hill Forest area has significant peat cover up to a maximum of 5.2 m depth this reduces significantly as the gradient of ground increases with respect to Brown Hill and Garbet Hill slope formations.

Substrate Geology(M

1.4.18 Table 2.5.4 shows substrate type, significance and related scores for the peat depth 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).

[13] Evans & Warburton (2007) Geomorphology of Upland Peat: Erosion

1.4.19 Peat failures are frequently cited in association with glacial till deposits in which an iron pan is observed in the upper few centimetres[14]. They have also been observed over glacial till without an obvious iron pan, or over impermeable bedrock. They are rarely cited over permeable bedrock, probably due to the reduced likelihood of peat formation.

Table 2.5.4: 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	Failures rarely associated with permeable bedrock (peat is often thin or absent), neutral influence on stability	0

1.4.20 Figure 2.5.7c shows the distribution of substrate geology scores across the Site. The results indicate that the Site is underlain mostly by impermeable bedrock, which is consistent with the solid geology recorded.

Peat Geomorphology (G)

1.4.21 Table 2.5.5 shows the geomorphological features identified across the Site, their significance and related scores.

Table 2.5.5: 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

1.4.22 Figure 2.5.7d shows the distribution of geomorphology scores across the Site. Several extensive areas of peat exposure were noted during the survey. These include:

- Crest of Garbet Hill, peat instability along exposures with basal peat erosion and haggs and groughs;
- Peat exposure along Priests Well Spring, local peat instability along exposures, haggs and groughs;
- Peat exposure to the north of Turbine 3 within the forest on Brown Hill. Peat instability along exposure with tension cracks, haggs, groughs, and peat flush associated with spring features;
- Localised instability along drainage ditches and watercourses within the forests at Brown Hill;
- Haggs and groughs were noted along the southern and eastern slopes of Craig Watch Hill; and
- Peat pipe and haggs noted to the west of Howeshalloch forestry area.

[14] Dykes A. and Warburton J. (2007) Mass movements in peat: A formal classification scheme. Geomorphology 86. (Evans & Warburton, 2007)

1.4.23 All development infrastructure has been located outside the areas listed above as part of design development.

Drainage (D)

1.4.24 Table 2.5.6 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[15]. 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 2.5.6: 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

1.4.25 Figure 2.5.7e shows the distribution of drainage feature scores across the Site. Artificial drainage within forestry and across moorland/ open areas was observed to be parallel to the slope during site walkover surveys.

Forestry (F)

1.4.26 Table 2.5.7 shows forestry classes, their significance and related scores. Areas of the Site have been extensively managed for both afforested and deforested areas. In both cases it was noted that the alignment of the forestry was predominantly aligned to the slope.

Table 2.5.7: 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

1.4.27 Figure 2.5.7g shows the distribution of forestry feature scores across the Site. Brown Hill and Howeshalloch are predominantly afforested areas with mature trees. No recent felling or secondary planting was noted during the survey. Areas to the south and east of Garbet Hill are not afforested.

Slope Convexity (C)

1.4.28 Table 2.5.8 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

[15] Warburton J, Holden J and Mills AJ (2004). Hydrological controls of surficial mass movements in peat

thicker peat upslope applies stresses to thinner 'retaining' peat downslope. Conversely, buckling and tearing of peat may trigger failure at concavities.

Table 2.5.8: Convexity Feature Classes, Significance and Scores

Convexity Feature	Significance	Score
Convex Slope	Peat failures are often reported on or above convex slopes	3
Concave Slope	Peat failures are occasionally reported in association with concave slopes	1
Rectilinear Slope	Rectilinear slopes show no particular predisposition to failure, neutral influence on stability	0

1.4.29 Figure 2.5.7f shows the distribution of convexity feature scores across the Site. The mapping shows the vast majority of the Site has rectilinear slopes.

Land use (L)

1.4.30 Table 2.5.9 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 2.5.9: 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

1.4.31 Figure 2.5.7h shows the distribution of land use feature scores across the Site. One area of the Site, within the Howeshalloch area, was noted as having historical peat cutting. The area is localised and located away from the Proposed Development infrastructure.

Likelihood Scores

1.4.32 The eight contributory factor layers shown on Figure 2.5.8 were combined in GIS software to produce likelihood scores for a peat landslide. 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 2.5.10 below.

Table 2.5.10: Likelihood Classes Derived from the Landslide Susceptibility Methodology

Summed Contributory Factor Scores	Typical Site Conditions Associated with Score	Qualitative Likelihood	Peat Landslide Likelihood Score
≤6	Unmodified peat with no more than low weightings for peat depth, slope angle, underlying geology and peat morphology	Very Low	1
7-11	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
12-16	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
17-21	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

1.4.33 Table 2.5.10 describes the basis for the likelihood classes, and professional judgement was used 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 12 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.

Results

1.4.34 The results of the Peat Slide Likelihood are shown on Figure 2.5.8 and indicate that the majority of the Site is considered to be of 'low' or 'very low' likelihood of a peat landslide.

1.4.35 Although the Proposed Development does overlap with some areas of peat, the layout has been optimised through micrositing to ensure that it avoids areas of "Moderate" or higher likelihood.

1.4.36 In order for there to be a "High" or "Medium" risk associated with proposed wind farm infrastructure, combined peat landslide likelihood must be "Moderate" or higher at an infrastructure location, as defined by Scottish Government Guidance[16].

1.4.37 Where combined peat landslide likelihoods are considered "Low" or "Very Low", the undertaking of post-consent Site investigations and application of good practice construction mitigation methods should be considered sufficient to progress the proposal.

1.5 Assessment of Consequence and Risk

1.5.1 Based on the assessment of consequence of risk methodology, as defined by best practice Guidance[18], three receptors have been identified at the Site, and are assessed for consequence in Table 2.5.11 below:

- watercourses;
- non-riverine habitats; and
- Proposed Development infrastructure.

Table 2.5.11: Assessment of Consequence and Risk

Receptor	Consequence	Score	Justification for Score	Consequence Scale
Watercourses	Increased turbidity and acidification, fish kill, blockage of drainage, effects on private water supplies	3	Flood risk assessment has been scoped out of the EIAR. Private water supplies have been assessed.	High
Non-riverine Habitats	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

[16] Scottish Government. (2017) Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments

Table 2.5.11: Assessment of Consequence and Risk				
Receptor	**Consequence**	**Score**	**Justification for Score**	**Consequence Scale**
Proposed Development Infrastructure	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 the Proposed Development are less significant	Extremely high

1.5.2 Table 2.5.12 below shows how the Risk Level is defined for each of the defined consequences when applied to the likelihood classification as defined in the previous section Table 2.5.10.

Table 2.6.12 Risk levels derived from Likelihood vs Consequence				
Receptor	**Qualitative Likelihood Worst Case (see Table 2.5.10)**	**Consequence Scale / Score (see Table 2.5.11)**	**Risk Level**	**Minimum Distance to Receptor**
Watercourses	Low (2)	High (3)	Low	50 m
Non-riverine Habitats	Low (2)	High (3)	Low	50 m
Proposed Development Infrastructure	Low (2)	Extremely High (5)	Low	100 m (Rinturk Farm)

1.5.3 Based on the likelihood and FoS assessment previously outlined, it is considered that the combined risk of peat landslide in association with the construction of the Proposed Development is assessed as being Low risk.

1.6 Risk Mitigation

1.6.1 A number of mitigation measures could be used to reduce the risk levels identified at the Proposed Development. These range from infrastructure-specific measures (which could act to reduce peat landslide likelihood, and, in turn, risk) to general good practice that should be applied across the Site to engender awareness of peat instability and enable early identification of potential displacements and opportunities for mitigation.

1.6.2 Typically, risks could be mitigated by:

- micrositing, use of the 50 m micrositing allowance to refine layout and reduce further the overlap between infrastructure and peat soils;
- reassessment once detailed ground investigation has determined site specific parameters; and
- precautionary construction measures – use of monitoring, good practice and a geotechnical risk register for each of the development locations.

1.6.3 These measures listed above may further reduce the already minimal risks present at the Site and are detailed below for the construction and post-construction phases.

Mitigation Recommended

1.6.4 A comprehensive intrusive ground investigation would be undertaken post-consent to support the engineering design of turbine foundations, tracks and ancillary infrastructure for the Proposed Development. This would comprise suitable field and laboratory testing to further inform the peat stability baseline, and further design mitigation used as appropriate to reduce the likelihood of peat instability.

1.6.5 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 Applicant's contractor.

1.6.6 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 be agreed with the Local Authority 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 (e.g. for turbines, 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; and
- 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).

1.6.7 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 it water remains free-flowing and that no blockages have occurred.

1.6.8 During construction of the Proposed Development the following mitigation would be undertaken for floating tracks:

- Allow peat to undergo primary consolidation by adopting rates of road construction appropriate to weather conditions.
- Monitor the effects of secondary compression over the life of the Proposed Development while the tracks are utilised (up to 33 years) to ensure running surfaces remain elevated above the ground surface and do not cause ponding.
- Identify 'stop' rules, i.e., weather dependent criteria for cessation of track construction based on local meteorological data.
- Run vehicles at 50% load capacity until the tracks have entered the second compression phase.

- Prior to construction, setting out the centreline of the proposed track to identify any ground instability concerns or particularly wet zones.

1.6.9 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.

1.6.10 During the operational phase of the Proposed Development monitoring of key infrastructure locations would continue through Site walkovers and inspections by the Applicant's 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.

1.6.11 This monitoring would be undertaken on a quarterly basis in the first year after construction, bi-annually in the second year after construction and annually thereafter. In the event that unanticipated ground conditions arise during construction, the frequency of these intervals should be reviewed, revised and justified accordingly, and a geotechnical risk register maintained by the operator.

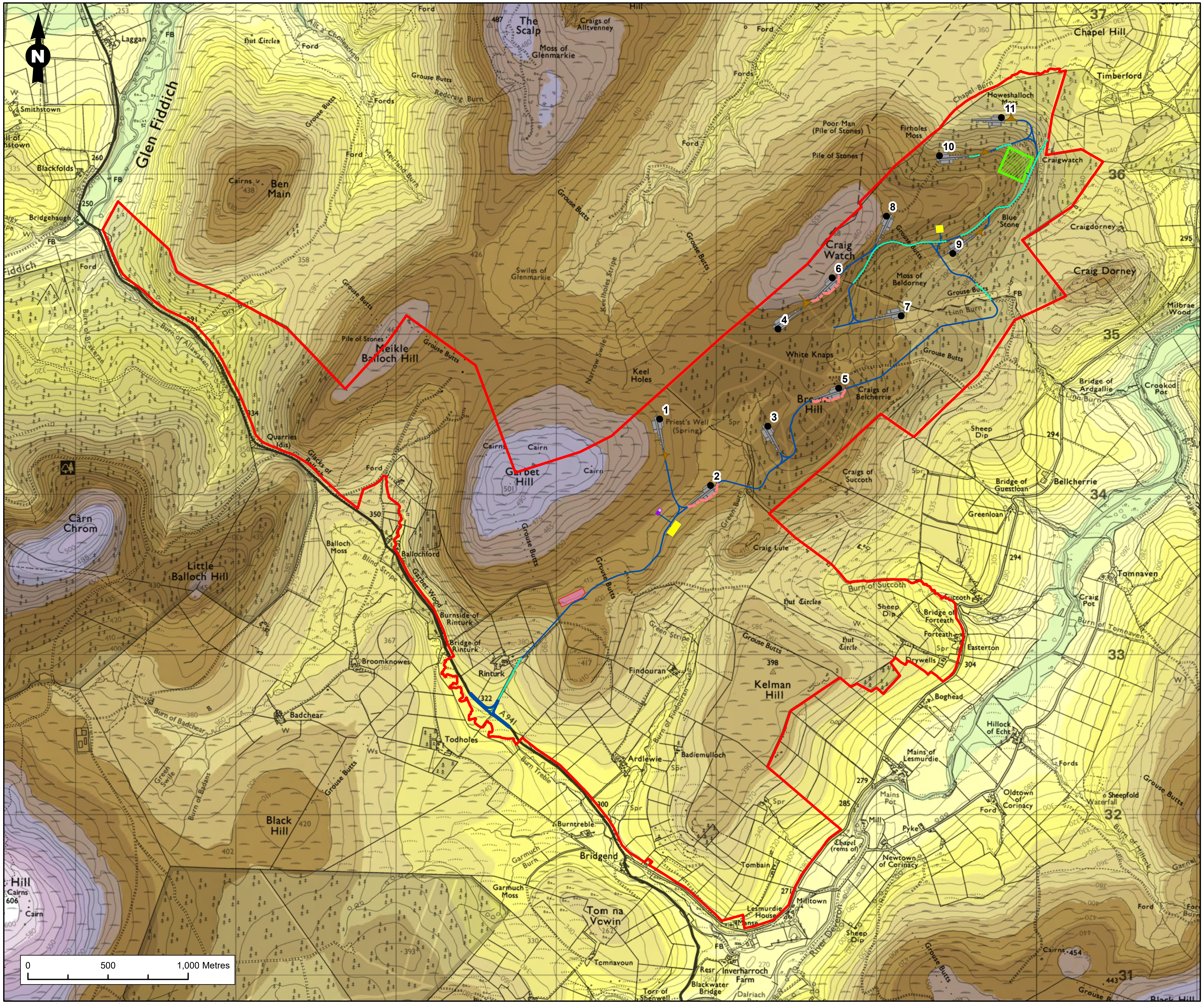


Figure Title
Figure 2.5.1: Elevation

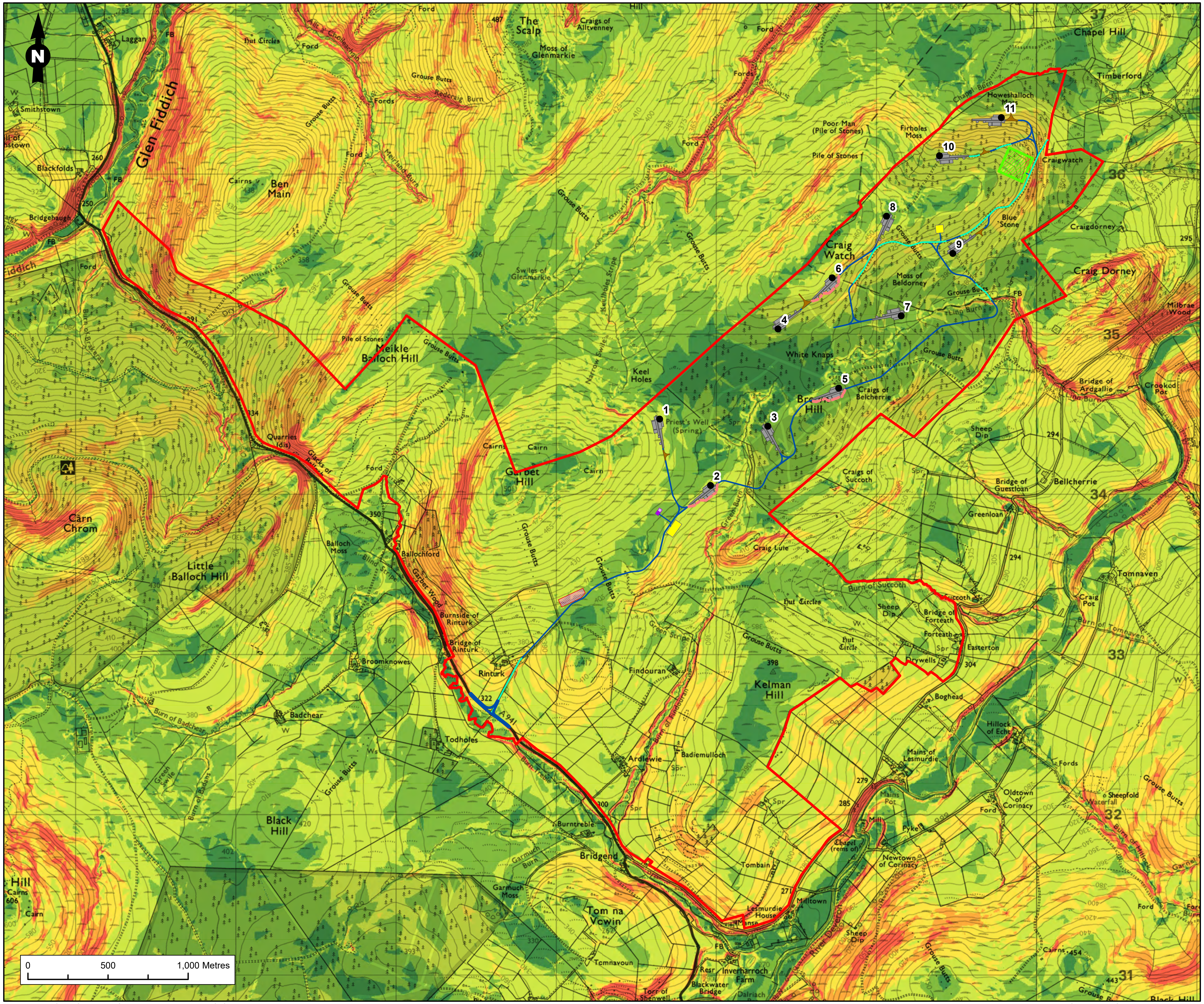
Project Name
Craig Watch Wind Farm EIA Report

Project Number	Figure No.
1620010178	2.5.1
Date	Prepared By
May 2022	AB
Scale	Issue
1:22,500 @A3	1

Client
Craig Watch Wind Farm Limited

RAMBOLL

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



Legend

- Site Boundary
- Proposed Turbine
- Proposed Turbine Hardstanding
- Proposed Temporary Construction Compound (CC)
- Proposed Substation
- Proposed Met Mast
- Proposed Met Mast Hardstanding
- Proposed Borrow Pit Search Area
- Proposed New Track
- Proposed Existing Track Upgrade
- Proposed Emergency Vehicle Access
- Proposed Turning Head

Slope Angle (Degrees)

- 0.1 - 2
- 2.1 - 5
- 5.1 - 10
- 10.1 - 15
- 15.1 - 20
- >20

Figure Title Figure 2.5.2: Slope Angle	
Project Name Craig Watch Wind Farm EIA Report	
Project Number 1620010178	Figure No. 2.5.2
Date May 2022	Prepared By AB
Scale 1:22,500 @A3	Issue 1
Client **Craig Watch Wind Farm Limited**	

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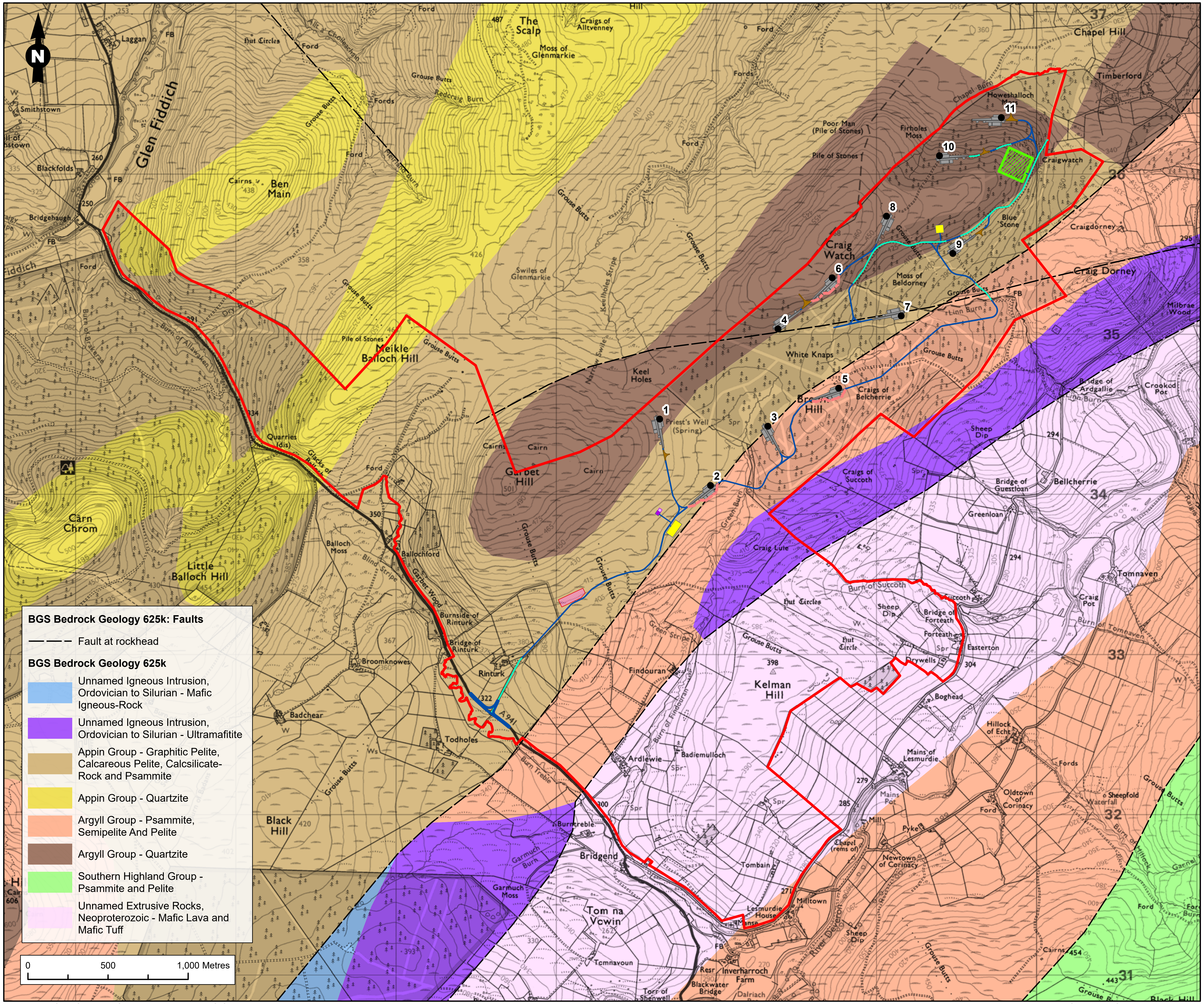
Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



Legend

- Site Boundary
- Proposed Turbine
- Proposed Turbine Hardstanding
- Proposed Temporary Construction Compound (CC)
- Proposed Substation
- Proposed Met Mast
- Proposed Met Mast Hardstanding
- Proposed Borrow Pit Search Area
- Proposed New Track
- Proposed Existing Track Upgrade
- Proposed Emergency Vehicle Access
- Proposed Turning Head

Figure Title	Figure 2.5.3a: Bedrock Geology
Project Name	Craig Watch Wind Farm EIA Report
Project Number: 1620010178	Figure No.: 2.5.3a
Date: May 2022	Prepared By: AB
Scale: 1:22,500 @A3	Issue: 1
Client	Craig Watch Wind Farm Limited

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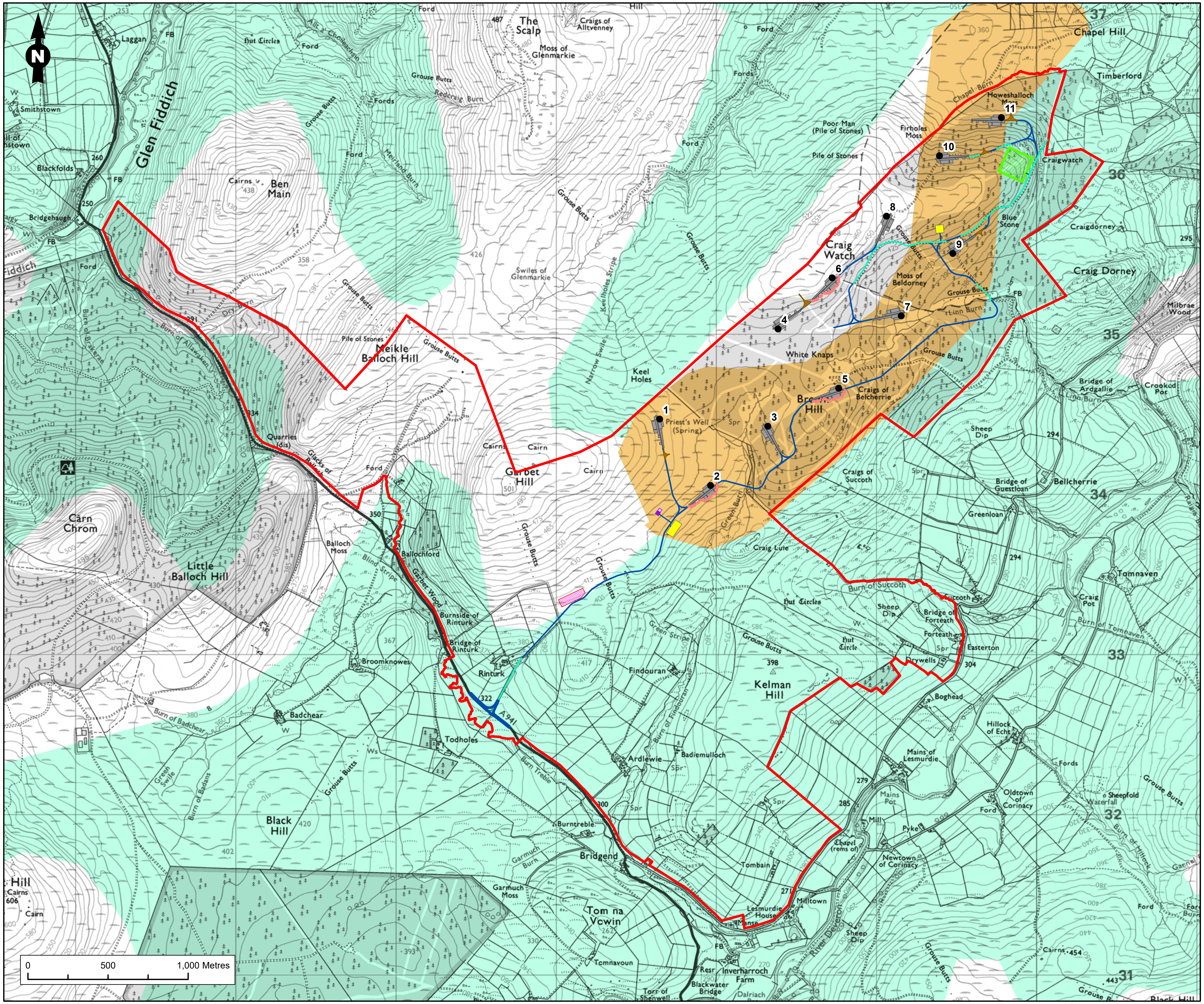
Coordinate System: British National Grid. Projection: Transverse Mercator. Datum: OSGB 1936.



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Legend

- Site Boundary
- Proposed Turbine
- Proposed Turbine Hardstanding
- Proposed Temporary Construction Compound (CC)
- Proposed Substation
- Proposed Met Mast
- Proposed Met Mast Hardstanding
- Proposed Borrow Pit Search Area
- Proposed New Track
- Proposed Existing Track Upgrade
- Proposed Emergency Vehicle Access
- Proposed Turning Head

BGS Superficial Geology 625k

- Peat
- Till, Diamicton

Figure Title	
Figure 2.5.3b: Superficial Geology	
Project Name	
Craig Watch Wind Farm EIA Report	
Project Number: 1620010178	Figure No.: 2.5.3b
Date: May 2022	Prepared By: AB
Scale: 1:22,500 @A3	Issue: 1
Client: **Craig Watch Wind Farm Limited**	

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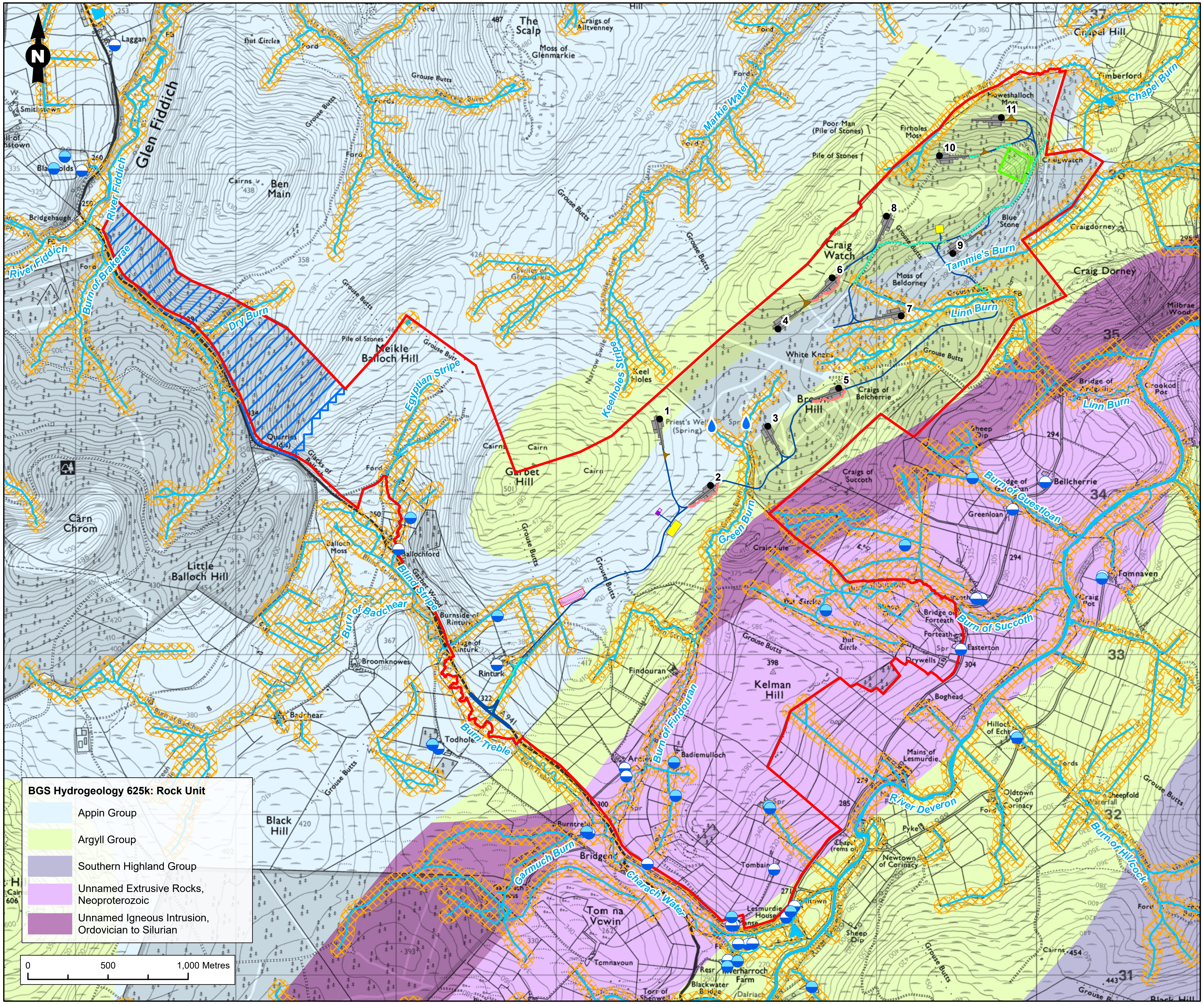

Legend

- Site Boundary
- Proposed Turbine
- Proposed Turbine Hardstanding
- Proposed Temporary Construction Compound (CC)
- Proposed Substation
- Proposed Met Mast
- Proposed Met Mast Hardstanding
- Proposed Borrow Pit Search Area
- Proposed New Track
- Proposed Existing Track Upgrade
- Proposed Emergency Vehicle Access
- Proposed Turning Head
- Spring
- Private Water Supply: Users
- Private Water Supply: Sources
- Surface Water Features
- Surface Water - 50 m Buffer
- River Fiddich Catchment Area

The entire site is within the river Deveron catchment.

Figure Title	
Figure 2.5.4: Geomorphology & Hydrology	
Project Name	
Craig Watch Wind Farm EIA Report	
Project Number	Figure No.
1620010178	2.5.4
Date	Prepared By
May 2022	AB
Scale	Issue
1:22,500 @A3	1
Client	
Craig Watch Wind Farm Limited	

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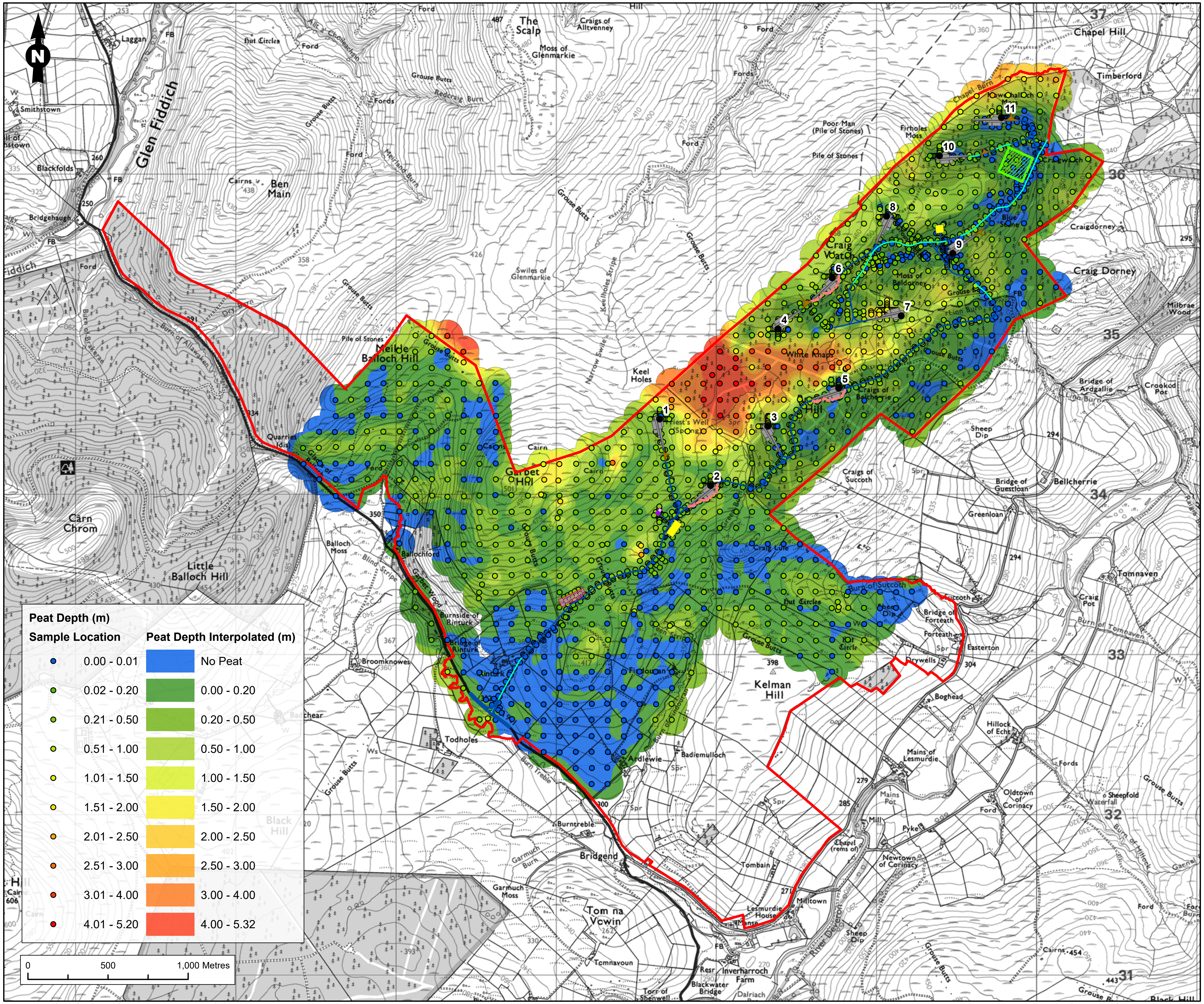

Figure Title
Figure 2.5.5: Peat Depth

Project Name
Craig Watch Wind Farm EIA Report

Project Number	Figure No.
1620010178	2.5.5
Date	Prepared By
May 2022	AB
Scale	Issue
1:22,500 @A3	1

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Craig Watch Wind Farm Limited

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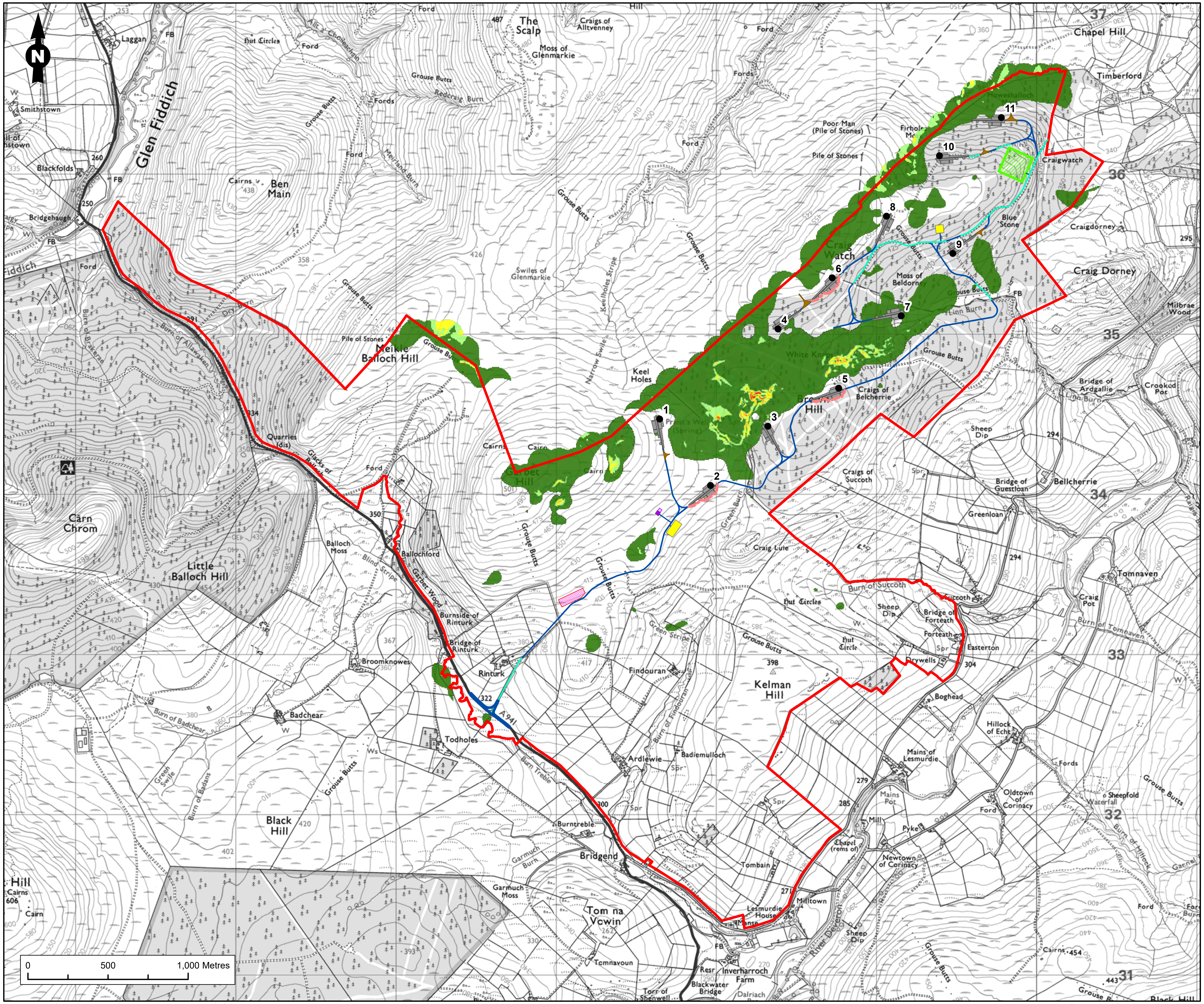

Legend

- Site Boundary
- Proposed Turbine
- Proposed Turbine Hardstanding
- Proposed Temporary Construction Compound (CC)
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- Proposed Met Mast Hardstanding
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- Proposed Existing Track Upgrade
- Proposed Emergency Vehicle Access
- Proposed Turning Head

Factor of Safety

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

Figure Title Figure 2.5.6: Factor of Safety	
Project Name Craig Watch Wind Farm EIA Report	
Project Number 1620010178	Figure No. 2.5.6
Date May 2022	Prepared By AB
Scale 1:22,500 @A3	Issue 1
Client **Craig Watch Wind Farm Limited**	

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