APPENDIX V2-7.2 – PEAT LANDSLIDE HAZARD AND RISK ASSESSMENT

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BASIS OF REPORT

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1.1 Introduction

This Stage 1 Peat Landslide Hazard and Risk Assessment (PLHRA) has been prepared by SLR Consulting Ltd (SLR) and forms a Technical Appendix to Chapter 7: Geology and Soils (Volume 2) of the Environmental Impact Assessment (EIA) Report, for the Skye Reinforcement Project (the Proposed Development).

The purpose of this report is to consider the potential risk of peat landslides occurring within the vicinity of the Proposed Development (also referred to in this report as 'the Site') such that suitable controls and appropriate methodologies can be employed during the construction and operation of the Proposed Development to mitigate against these risks. This report presents the findings of the peat slide hazard and risk assessment based on the data obtained by peat depth probing surveys which were undertaken by SLR in November and December 2021 and January/February 2022.

This report should be read in conjunction with the site-specific Peat Management Plan (PMP) (see **Appendix V2-7.3**) and **Volume 2, Chapter 7: Geology and Soils** of the EIA Report. This report includes consideration of the Alternative Alignment within Section 3 of the project, which is assessed within **Volume 6, Chapter 7: Geology and Soils**.

It is noted that the PLHRA would be updated and revised as required following the finalised site design and following completion and analysis of Site Investigation (SI) information to inform the detailed site design. Where available, SI data has been referred to in this PLHRA to confirm the interpretation of peat survey data and desk-based findings.

This PHLRA will be further developed during the detailed design process and will form part of the appointed Principal Contractor's Construction Environmental Management Plan (CEMP) for the Proposed Development.

1.1.1 Scope of Assessment

The main objective of this report is to assess the potential peat stability, identify areas of potential concern and identify mitigation measures to ensure the maintenance of peat stability before, during and after construction.

The methods adopted for the assessment follow the best practice guidance [1] issued by the Scottish Executive (now the Scottish Government) for investigation, assessment and reporting for Proposed Electricity Generation Developments in peat areas.

The analysis and interpretation are based upon the results obtained from this process as well as previous experience and the results of case studies elsewhere. Where deviations from this guidance have occurred, this is highlighted and explained in the text.

An initial desktop assessment was undertaken by SLR to establish the presence of peat forming habitats along the Proposed Development. This was followed by a peat probing campaign to identify the depth of peat across the route of the Proposed Development.

1.2 Methodology

This assessment has been completed by a desk-based review of soil and geological maps and OS contour data. No intrusive investigation has been undertaken on site by SLR, other than visual field mapping and peat probing. SI work has been undertaken across large parts of the Proposed Development route by Card Geotechnics Ltd and this has been used to compliment the data gathered as part of the peat probing campaign.

[1] Scottish Government (April 2017) Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition).

This report summarises the findings of the desk study and provides an assessment of the prevailing ground conditions as they relate to peat stability issues at the Site.

1.2.1 Desk Study

Desktop data was reviewed by SLR, including aerial photographs and Ordnance Survey (OS) 1:25,000 scale mapping of the Site which included a 50 m Digital Terrain Model (DTM). The aerial photography consisted of ortho-rectified colour images; no stereoscopic aerial photographs were available for the Site.

The desk study methodology included a review of all the following aspects:

- review preliminary layout of Proposed Development;
- review topographical surveys;
- review available aerial photography;
- review of onsite land use;
- review historical and geological maps and publications;
- review of onsite hydrology and hydrogeology;
- review of aerial photographs;
- review of peat stability issues in the surrounding area; and
- review of potential impact receptors.

This desktop assessment also included review of the following:

- NatureScot Environment map viewer[2];
- British Geological Survey (BGS) Geoindex mapping[3];
- NatureScot SiteLink[4];
- Department for Environment, Food and Rural Affairs (DEFRA) Multi-Agency Geographic Information for the Countryside (MAGIC) online viewer[5];
- Public Health England UK Radon Map[6];
- The Coal Authority Interactive Map[7];
- Zetica UXO Risk Maps[8]; and
- A review of current and historical Ordnance Survey maps.

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[2] Scottish Natural Heritage (SNH), The James Hutton Institute and Scottish Government., (2016). available at: www.environment.scotland.gov.uk [Accessed 22 March 2022]
[3] British Geological Survey (BGS) Online Viewer/Geoindex website, available at: http://mapapps.bgs.ac.uk/geologyofbritain/home.html ; http://www.bgs.ac.uk/geoindex / [Accessed 22 March 2022]
[4] NatureScot SiteLink, available at: https://sitelink.nature.scot/about [Accessed 22 March 2022]
[5] Department for Environment, Food and Rural Affairs (2013), available at: https://magic.defra.gov.uk/ [Accessed 22 March 2022]
[6] UK Radon Map (2022), available at: https://www.ukradon.org/information/ukmaps [Accessed 22 March 2022]
[7] Coal Authority (2022), available at: https://mapapps2.bgs.ac.uk/coalauthority/home.html [Accessed 22 March 2022]
[8] Zetica UXO (2022), available at: https://zeticauxo.com/downloads-and-resources/risk-maps/ [Accessed 22 March 2022]

Investigation reports were produced by Card Geotechnics Ltd following SI works across the large parts of the route. These were used to compliment the data gathered as part of the peat probing campaign. SLR reviewed reports undertaken in Sections 1, 2, 3, 4, 5 and 6.

1.2.2 Site Visit

Detailed site visits and walkover surveys have been undertaken by SLR on the following dates:

- October 2021 – reconnaissance visits of the entire length of the route was walked or driven.
- November / December 2021 – Section 3 peat probing to collect peat depth and condition data.
- January/February 2022 – peat probing to collect peat depth and condition data, primarily along Sections 0, 1, 2, 3 and 6. Limited probing has been undertaken along Sections 4, 5 and 6, and the assessment for these sections has been primarily desk based supported by GI information.

The field work has been undertaken to:

- verify the information collected during the desk and baseline study;
- undertake a visual assessment of the site and main geological features;
- inspect rock exposures and establish by probing, an estimate of overburden thicknesses, peat depth and stability;
- confirm underlying substrate, based on the type of refusal of a peat probe and by coring; and
- allow appreciation of the Site, determine gradients, review access routes, ground conditions, etc., and to assess the relative location of all the components of the Proposed Development.

Site Investigation (SI) reports were produced by Card Geotechnics Ltd following SI works across large parts of the Proposed Development route. These were used to compliment the data gathered as part of the peat probing campaign. SLR reviewed reports undertaken in Sections 1, 2, 3, 4, 5 and 6.

1.3 Summary of Geology along the Route

1.3.1 Bedrock Geology

The Isle of Skye can be divided in to three distinct geological areas. The north of Skye including the Watermish Peninsula (Sections 0 and Section 1) comprises the laterally extensive and thick Paleogene plateau type lava fields and pyroclastic rocks, overlying Jurassic sedimentary rocks which crop out along the east coast. The Skye Lava Group mainly comprise basalt and basic tuffs.

The central portion of the island is dominated by Skye Western and Eastern Red Hills Centre, the last focal point of volcanic activity preserved on Skye (Section 2). These, with the Cullins Hills, give rise to the mountainous region in the centre of Skye. The Red Hills are formed by Lower Tertiary (Paleogene) intrusive rocks dominated by gabbro and granite. The igneous rocks have been intruded into the older Torridon and Lias Group sedimentary rocks, which still crop out in some locations.

The Sleat Peninsula and the eastern part of the island comprises Neoproterozoic sedimentary rocks of the Torridon and Sleat groups with Paleaogene igneous intrusions (Section 3). These units lie to the west of the Moine Thrust, which trends northeast southwest through the Sound of Sleat and the Sleat Peninsula and have been subject to faulting and folding.

East of the Moine fault (Section 4), Archaean age basement gneiss inliers (the Lewisian Complex) overlain are by younger Morar and Glenfinnian psammites and pelites. The deposits typically follow a west to east younging pattern. Further southeast between Loch Quioch, Invergarry and Fort Augustus (Section 5 and Section 6) the psammites of the Loch Eil Group (Moine Supergroup) is the predominant geological unit with lithologies of the West Highland Granite Gneiss Intrusion and of the Argyll and Northern Highlands Granitic Suite. The region has been subject to significant metamorphism, thrusting and folding during tectonic and seismic activity during the Ordovician-Silurian Caledonian Orogeny. There are a range of igneous intrusions and dykes intersecting the older meta-sedimentary rocks.

1.3.2 Superficial Geology

The superficial geology across the north-western part of the Isle of Skye comprises areas of alluvium, peat and till deposits (Section 0 and Section 1). Sporadic areas within the study area are mapped without superficial deposits indicating that bedrock is at or near the surface. Alluvium is generally associated with the valleys of rivers and streams. The Varragill and Drynoch Rivers are also associated with Hummocky (moundy) Glacial Deposits. Between Loch Sligachan and Broadford Bay (Section 2) there is an absence of mapped superficial deposits across much of the area indicating the bedrock is at or near surface. Between Broadford and Kyle Rhea (Section 3) the coastal areas are mapped as marine deposits, while the upland areas around Beinne na Greine and other summits comprise sporadic till and moranic deposits or bedrock at the surface.

On the mainland the published mapping indicates that much of the area (Section 4, Section 5 and Section 6) is absent of superficial deposits and bedrock is marked at or near the surface. Where present the superficial geology comprise Quaternary age till and morainic deposits, hummocky glacial deposits, isolated pockets of peat and alluvium associated with the river valleys.

The Carbon and Peatland Map[9] shows the distribution of carbon and peatland classes across the whole of Scotland. The classification ranges from Class 1 and 2 Nationally Important carbon rich soils to Class 4 and 5 predominantly mineral soils with some peat. It is a coarse method for classifying peat areas and is uses as a guide to classify peat, which can be further modified by site specific mapping and assessment. The Map records the north and western part of Skye as Class 1 peatland, the central part of the island is generally recorded as Class 3, while the eastern part of the island, where peat is mapped, records a variety of classes from Class 1 to 5. On the mainland where peat is mapped, it is generally Class 2 or 5, with pockets and isolated areas of other peat classes.

1.4 Field Work

The desk study and field surveys have been used to identify potential development constraints and have been used as part of the iterative design process.

All the identified peat areas were inspected, and confirmation probing was undertaken. The inspection was not limited to the immediate boundaries of the mapped peat areas but included observations of areas both up-slope and down-slope of the route, where relevant and along access routes where appropriate, although many of these tracks were existing tracks used locally for estates and forestry.

A peat probing exercise at over 5800 locations across the Proposed Development, including targeted peat probing at 854 tower or wood pole locations was undertaken (403 wood pole locations and 451 tower locations). The location of the probes was chosen following site reconnaissance in combination with the location of the inferred peat rich soils/peat from the desk study, along the route of the Proposed Development. A complete list of data from the peat probing exercise is included in **Annex A: Peat Probes.**

The aim of the survey was to characterise the peat depth within the Limits of Deviation (LoD). This typically comprised one peat probe at the centre of a proposed pole or tower location, and points located within the LoD.

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[9] 9 NatureScot, (2016) Carbon and Peatland 2016 map. Available from: http://map.environment.gov.scot/soil_maps/ Scottish Government, 2016, [Last accessed 22 March 2022]

Sampling was undertaken along the cable route and varied subject to ground conditions, where the ground was predominantly shallow rock the probes were undertaken every 50 m and where the ground was a softer substrate, two lines were undertaken at 50 m intervals within the identified cable LoD. This data is also supported by SI information along the route.

Data collection characterised peat depth and provided preliminary information on balance of catotelmic and acrotelmic peat. The data has been used to support the production of peat depth mapping and to inform both the production of this PLHRA, and a Stage 1 Peat Management Plan (PMP), included as **Appendix V2-7.3**.

1.5 Peat Survey Methodology

The thickness of the peat was assessed using a graduated peat probe, approximately 6 mm diameter and capable of probing more than 10 metres. This was pushed vertically into the peat to refusal and the depth recorded, together with a unique location number and the co-ordinates from a handheld Global Positioning System instrument (GPS). The accuracy of the GPS was quoted as ±4 metres, which was considered sufficiently accurate for this survey. All data was uploaded into a GIS database for incorporation into various drawings and analysis assessments.

Where the peat probing met refusal on a hard substrate, the 'feel' of the refusal can provide an insight into the nature of the substrate. The following criteria were used to assess material:

- Solid and abrupt refusal – rock;
- Solid but less abrupt refusal with grinding or crunching sound – sand or gravel or weathered rock;
- Rapid and firm refusal – clay; or
- Gradual refusal – dense peat or soft clay.

An assessment of the substrate was made and recorded at each probe hole.

The relative stiffness of the peat was also assessed from the resistance to penetration of the probe and to the effort required to extract the probes (retrieval of the probe was often impossible for one person). Some areas, especially on slopes, were a little drier, resulting in the peat being stiffer and more difficult to fully penetrate. In all instances refusal was met on obstructions allowing identification of subsurface geology.

There was no cohesive substrate material identified on the Site.

1.5.1 Peat

The peat was found to vary across the Site in terms of thickness, surface slopes and apparent natural characteristics.

Peat thickness varies from zero to 7.8 m along the route. Accumulations of peat less than 0.5 m thick are too thin to be classified as true peat deposits and are often classified as organic soils or peaty soils. The peat thickness was examined by review of the probe information from the investigation and is discussed below.

The geomorphology of the peat areas varies between some flat expanses of thick peat with high moisture content and smaller areas of thinner drier deposits blanketing the flanks of the hills.

The peat thickness at each location was recorded and the data used to produce peat depth plans **(see Figures V2-7.4** of **Volume 2, Chapter 7: Geology and Soils**).

The shear strength of the peat was assessed from inspection of natural exposures and found to be in the range very soft to firm (<10-45 kPa).

The strength of the peat in the upper acrotelm is significantly influenced by the root and fibres that are abundant in this layer. The probing investigation identified the following profiles within the peat:

- Soft to firm from surface to base of peat;
- Firmer, vegetative root system at surface to approximately 100 cm, underlain by slightly softer, partially waterlogged peat to base, particularly more than 1.0m; and
- Vegetation still present to base of peat less identifiable and certainly more decomposed.

1.5.2 Substrate

From the evidence of the probing and sampling where available, the substrate falls into one of two principal categories:

- Sand and/or gravel of glacial origin but occasionally of alluvial origin in the valley bottoms; or
- Rock, no rock samples were recovered from the probe locations although, where exposed, the material was seen to be strong to very strong bedrock.

No clay or cohesive horizons were encountered and evidence from the site walkovers did not encounter cohesive soils on site.

1.5.3 Peat Instability

This part of the report reviews the nature of peat and how current and past activities can influence stability. The factors which are likely to influence the potential for peat instability are:

- Significant peat depths over impermeable bedrock or minimal soil;
- The presence of slope gradients greater than 4^{o} (approximately) and general topography;
- Natural drainage paths;
- Evidence of past failures, including soil creep;
- Drainage features at the base of slopes which could lead to undercutting;
- Forestry plantations and artificial drainage; and
- Recent climate patterns.

It should be noted that peat instability is not a recent phenomenon and there is documentary evidence of peat landslides dating back over 500 years[10]. Many landslides that involve peat have no human interference that could be considered as a trigger, and this should be borne in mind when considering the susceptibility of a site to potential instability.

1.5.4 Background Information Regarding Peat

Peat is found in extensive areas in the upland and lowland regions of the UK and is defined as the partly decomposed plant remains that have accumulated in-situ, rather than being deposited by sedimentation. When peat forming plants die, they do not decay completely as their remains become waterlogged due to regular rainfall. The effect of water logging is to exclude air and hence limit the degree of decomposition. Consequently, instead of decaying to carbon dioxide and water, the partially decomposed material is incorporated into the underlying material and the peat ‘grows’ in-situ.

Peat is characterised by low density, high moisture content, high compressibility, and low undrained shear strength, all of which are related to the degree of decomposition and hence residual plant fabric and structure.

[10] Smith, L.T., (Ed) (1910), ‘The literary of John Leland in or about the years 1535-1543.’ Vol.5, Part IX. London: AF Bell and Sons.

To some extent, it is this structure that affects the retention or expulsion of water in the system and differentiates one peat from another.

Lindsay [11] defined two main types of peat bog, raised bog and blanket bog, which are prevalent on the west coast of Europe along the Atlantic seaboard. In Britain, the dominant peat land is blanket bog which occurs on the gentle slopes of upland plateaux, ridges and benches and is supplied with water and nutrients in the form of precipitation. Blanket peat is usually considered to be hydrologically disconnected from the underlying mineral layer.

There are two distinct layers within a peat bog, the upper acrotelm and the lower catotelm. The acrotelm is the fibrous surface to the peat bog[12], typically less than 0.5 m thick; which exists between the growing bog surface and the lowest position of the water table in dry summers. Below this are various stages of decomposition of the vegetation as it slowly becomes assimilated into the body of the peat.

For geotechnical purposes, the degree of decomposition (humification) can be estimated in the field by applying the 'squeezing test' proposed by von Post and Grunland [13] (1926). The humification value ranges from H1 (no decomposition) to H10 (highly decomposed). The extended system set out by Hobbs [14] provides a means of correlating the types of peat with their physical, chemical and structural properties.

The relative position of the water table within the peat controls the balance between accumulation and decomposition and therefore its stability, hence artificial adjustment of the water table by drainage requires careful consideration.

1.5.5 Peat Undrained Shear Strength

In geotechnical terms, the undrained shear strength of a soil is the physical characteristic that provides stability and coherence to a body of soil. For mineral soils such as clays or sands, such strength is variously given by an inter-particle friction value and cohesion. Depending on whether the mineral soil is predominantly cohesive (clay) or non-cohesive (sand) governs which of the components of strength control the behaviour of the soil.

For peat soils, where the major constituent is organic and there is likely to be little or no mineral component, the geotechnical definition of undrained shear strength does not strictly apply. At present there is no real alternative method for defining the undrained shear strength of peat, therefore the geotechnical definition is generally adopted, in the knowledge that it should be used with great caution.

As noted before, the acrotelm or near surface peat comprises a tangle of fresh and slightly rotted roots and vegetable fibres. These roots and fibres impart a significant tensile shear strength capacity to the material which provides it with a significant load carrying capacity. The acrotelm is, in effect, a fibre reinforced soil.

In the more decomposed catotelm, the tensile shear strength is reduced as the roots and fibres become more rotted. However, the loss in strength due to decomposition is off-set to a limited degree, by a gain in strength due to the overburden pressure. In geotechnical engineering there is an established relationship for recently deposited soils, between the undrained shear strength of a sample and the thickness of overburden above it.

Consequently, it is almost impossible to predict an undrained shear strength profile in peat and attempts to measure the undrained shear strength using normal geotechnical methods can be misleading. Typical values of undrained shear strength from hand shear vanes would be in the range 20-60 kilopascal (kPa) although values over 100 kPa have been recorded in peat elsewhere. The higher strengths are certainly the influence of roots or other non-decomposed material. It is believed that the strength of peat should be quoted as a cohesion value as

[11] Lindsay, R.A., (1995), 'Bogs: The ecology, classification and conservation of Ombrotrophic Mires.' Scottish Natural Heritage, Perth
[12] Ingram, H.A.P., (1978), 'Soil layers in mires: function and terminology'. Journal of Soil Science, 29, 224-227.
[13] Von Post, L. and Grunland, E., (1926), 'Sodra Sveriges torvillganger 1' Sverges Geol. Unders. Avh., C335, 1-127.
[14] Hobbs, N.B., (1986), 'Mire morphology and the properties and behaviour of some British and foreign peats.' Quarterly Journal of Engineering Geology, London, 19, 7-80.

there are few, if any, discrete particles to give the material a significant frictional resistance. It should be noted, however, that any quotation of undrained shear strength for peat should be treated with extreme caution.

1.5.6 Peat Stability – factors to be considered

There is considerable observational information relating to debris and peat flows although the actual mechanisms involved in peat instability are not fully understood. The main influences on slope stability are geological, geotechnical, geomorphic, hydrological, topographic, climatic, agricultural and human influences such as drainage and construction activity. Peat is affected to a degree by changes in any of the above list and it is vital to appreciate that changes to the existing equilibrium would affect the level of slope stability during construction and operation of the scheme.

Some of the contributory factors to peat instability are summarised below:

- The geographical limits which could be affected by potential instability are not confined to the artificial boundaries imposed by land ownership; landslip occurring above a site could affect the site and property down slope or downstream of the site for several kilometres;
- Agriculture and grazing have a substantial effect on peat areas and this can be compounded in areas that have been managed to improve grazing. Grazing compacts the peat surface reducing the rainwater infiltration and the additional nutrients change the ecological balance of the original peat bog. Agricultural management can include surface drainage and periodic burning, both of which can leave the surface of the peat bare for a period resulting in temporary desiccation of the surface. Subsequent wetting of the peat and resumption of peat accumulation results in the former desiccated and ash covered surface being incorporated into the body of the peat which introduces a weak discontinuity in the profile; this in turn becomes another unknown factor in the stability assessment.
- Forestry has a substantial effect on slope stability particularly in the early stages as the creation of a forest involves disruption of the natural equilibrium and drainage of the slopes and the installation of artificial drains by deep ploughing. The construction of access tracks further disrupts the drainage and concentrates groundwater flow into narrow, fast flowing erosive streams. The work by Winter et al [15] noted that forest tracks can act to retard or concentrate the down slope flow of water and thus aid its penetration into the slope below. Such a mechanism has been observed at several recent landslips that have affected the road network in Scotland.
- Natural Drainage – some of the precipitation falling onto a natural upland peat bog would be absorbed into the low permeability catotelm peat. However, most of the water would run-off as sheet flow through upper, high permeability acrotelm. Thus, the water is transmitted to the lower slopes in a controlled manner through a range of interconnections that operate at different scales and speed. Failure to understand this and to disrupt the transmission process for the groundwater could result in instability.
- Artificial Drainage - Where agricultural drainage has been used to improve the quality of the grazing or to promote forestry it reduces the overall volume of water entering the bog and transfers this water to the edges more rapidly. This can result in ditches and streams becoming enlarged, causing increased erosion and a greater silt burden in the stream water.

[15] Winter, M.R., Macgregor, F. and Shackman, L. (2005a), 'Scottish tracks networks landslide study' Trunk tracks: network management division, published report series. The Scottish Executive.

1.5.7 Peat Mass Stability

The principal surface indicator of peat slide potential is cracking of the peat land surface and it is the identification of crack patterns in the field and the attendant causes of the cracking that is fundamental to a peat stability assessment.

Sites that have exhibited natural instability in the past are likely to be more susceptible to future instability during and following construction activity, therefore it is important to identify such instability as part of the Peat Stability Assessment.

1.5.8 Types of Failure

The result of instability in peat is the down-slope mass movement of the material; there are several definitions of peat instability which are used to characterise the type of failure. A brief description is given below:

- Bog Bursts or Bog Flows – the emergence of a semi-fluid form of well humified, amorphous peat from the surface of a bog, followed by the settling of the residual peat, in-situ[16]. Bog Bursts refer to failure of a raised bog and Bog Flows refer to failure of blanket bog, where the emergence of semi-fluid peat is from a clearly defined source;
- Peat Slides – the failure of a blanket bog at or below the peat/ substratum interface leading to translational sliding of detached blocks of surface vegetation together with the whole underlying peat stratum;
- Peaty Debris Slides – the failure of blanket bog on a hillslope in which failure occurs by shearing within the substratum below the interface with the base of the peat, such that the peat is only a secondary influence on the failure; and
- Bog Slide – an intermediate form of instability where failure occurs on a surface within the peat mass with rafts of surface vegetation being carried by the movement of a mass of liquid peat.

1.5.9 Bog Bursts

Accounts of bog bursts are associated with very wet climates or areas which have received storm rainfall events. Bog bursts can be associated with particularly wet peat landscapes; therefore, it is possible to identify broad regions of a higher susceptibility to these failures. The constraints used to identify the areas of higher susceptibility to bog burst failure are given below:

- Typical peat thicknesses of 2-5 m[17];
- Shallow gradients from 2^{o} to 5^{o} [10];
- Ground which is annually waterlogged to within the upper 1 m below ground level (the groundwater level may rise above this but rarely falls below) [18];
- Greater humification of the lower catotelm within the waterlogged ground;
- Lower surface tensile strength of the fibrous peat and vegetation; and
- The humified mass can be considered as analogous to a heavy liquid and the stability of this mass is maintained by the strength of the surface or acrotelm peat. Should the surface become weakened

[16] Dykes, A.P and Kirk, K.J., (2001), 'Initiation of a multiple peat slide on Cuilcagh Mountain, Northern Ireland.' Earth Surface Processes and Landforms, 26, 395-408.
[17] Dykes, A.P and Warburton, J. (2007) Mass Movements in peat: a formal classification scheme. *Geomorphology,* **86**, pp73-93
[18] Crisp, D.T., Dawes, M. & Welch, D. (1964), 'A Pennine Peat Slide', The Geographical Journal, Vol 130, No4, pp519-524.

through erosion or desiccation or the construction of a surface drainage ditch for agricultural or forestry reasons or through turbary (peat cutting), failure is made more likely.

1.5.10 Peat Slides

Peat slides tend to be translational failures with a defined shear surface at or close to the interface with the substrate.

The factors considered to influence susceptibility to peat slide failures are listed below:

- Typical peat depth up to 3 m[10];
- Typical slope gradients between 5° and 8° [10];
- Natural or artificial drainage cut into the surrounding peat landscape;
- Greater humification of the lower catotelm within the waterlogged ground; and
- Lower surface tensile strength of the fibrous peat and vegetation.

It will be noted that some of the factors causing instability are common to both bog bursts and peat slides.

The peat – substrate interface is the primary zone of failure and is enhanced by elevated water content at this boundary and softening or weathering of the lower mineral surface. For this reason, any investigation or probing should try to distinguish the nature of the lower mineral substrate.

1.5.11 Bog Slides

A bog slide is a variation on a peat slide where part of the peat mass is subject to movement, usually on an internal layer of material, which may be more prone to movement, such as an interface between the acrotelmic and catotelmic layer.

1.5.12 Natural Instability

The stability of a peat mass is maintained by a complex interrelationship of many factors, some of which may not be immediately obvious. Key factors include sloping rock head and proximity to a water body. Rainfall often acts as the trigger after the slope has already been conditioned to fail by natural processes.

It should also be remembered that peat bogs are growing environments and that there would come a time, on sloping ground, where the forces causing instability, i.e., the weight of the bog, can no longer be resisted by the internal strength of the peat and its interface with the underlying mineral surface. At this point, failure would occur.

The weight of the peat bog or any soils mantling steep hill slopes would be increased during periods of very heavy rain and it is common to see landslips occurring following extreme rain events. This may be a concern for future developments where one of the predicted effects of global warming will be a greater frequency of extreme weather, intense storms being one element.

Table 1-1
Risk Ranking

Risk	
Negligible	Project should proceed with monitoring and mitigation of peat landside hazards at these locations as appropriate

Risk	
Low	Project may proceed pending further investigation to refine assessment and mitigate hazard through relocation or redesign at these locations
Medium	Project should not proceed unless risk can be avoided or mitigated at these locations, without significant environmental impact, to reduce risk ranking to low or negligible
High/Very High	Avoid project Development at these locations

This part of the Appendix outlines the approach taken and the scores allocated for various factors relevant to peat stability.

At this stage in the Proposed Development, the objective is to determine the peat areas that would influence the Proposed Development (probability of a peat landslide) to determine the potential adverse consequences should a peat landslide occur and determine the overall Risk Ranking. Based on these factors, mitigation has been identified that could be adopted and incorporated into the overall development plan to ensure that due cognisance is taken in this regard.

The level of slope is normally assessed by reference to the factor of safety, which is expressed, numerically, as the degree of confidence that exists, for a given set of conditions, against a particular failure mechanism occurring. It is commonly expressed as the ratio of the load or action which would cause failure against the actual load or actions likely to be applied during service. This is readily determined for some types of analysis (e.g., limit equilibrium slope stability analyses). The following paragraphs present a brief discussion on some of the issues relating to stability and risk assessment.

The stability of peat is a complex subject and there are numerous inter-relationships that affect the stability.

A quantitative assessment requires a numerical input and such an analysis cannot account for the unquantifiable input required for a comprehensive peat stability assessment. For this reason, a purely quantitative assessment should only be considered as a guide and a qualitative assessment of stability should be used to inform the final recommendations.

The characteristics of the peat failure phenomena have been incorporated in a stability risk assessment to evaluate the risk of instability occurring within the peat areas. The main factors controlling the stability of the peat mass are the surface gradients, the depth and condition of the peat at each location and the type of substrate.

The natural moisture content and undrained shear strength of the peat are important; however, it is accepted that where present, the peat would be saturated and have a very low strength. It is believed to be unrealistic to rely on specific values of undrained shear strength to maintain stability when back analysis of failed slopes indicates that there is often a significant discrepancy between measured strength in peat and stability. Therefore, shear strength has been assumed to be constant and worst case, throughout this assessment. It has also been assumed, as a worst case, that the groundwater level is coincident with the ground surface.

The key factors identified as being critical to stability and the development of a risk ranking system is:

A – Slope gradient;

B – Peat thickness;

C – Substrate type or condition; and

D – Historic instability.

The risk scores are multiplied together to generate a risk rating which is a measure of the likelihood of peat instability.

1.6 Slope Gradients

The slope gradients were assessed by reference to the mapping and particularly the DTM which was used to generate a gradient map, from which the gradient at each probe location could be determined and input into the risk rating spreadsheet (Table 1-6). The gradient quoted at each location was based on the average gradient over a 5 m grid.

Table 1-2
Coefficients for Slope Gradients

Slope Angle (°)	Slope Angle Coefficients
Slope <2^0	1
2^0≤ Slope <4^0	2
4^0≤ Slope <8^0	4
8^0≤ Slope <12^0	6
>12° Slope	8

Coefficients for slope gradient have been assigned to ensure the potential for both peat slides (gradients of 4-15^0) and bog slides (gradients of 2-10^0) are addressed (See Table 1-2).

By simple inspection steeper slopes pose a greater risk of instability than shallow gradients. Therefore, a graduated gradient scale from 0^0 to >12^0 (the practical maximum gradient on which peat is commonly observed) has been applied.

It is evident from the slope plan (Figure V2-7.2.2 and V2-7.2.4) that most of the route is located on areas with moderate to steep gradients (4-12°).

1.7 Peat Thickness and Ground Conditions

The ground conditions were assessed by using peat depths recorded during peat probing. Thin peat was classed as being 0.5 m to 1.0 m thick, with deposits more than this being classed as thick. The thickness ranges used are intended to reflect the risk of instability associated with both peat slides and bog slides. Where the probing recorded peat less than 0.5 m thick, this has been classified as an organic soil rather than peat. **Table 1-3** gives the coefficients applied to the various ground conditions.

In addition to peat thickness, the presence of existing landslip debris or indicators of meta-stable conditions such as tension cracks or slumping in the peat suggest the material is likely to become even less stable should the existing ground conditions change. Where evidence of historical slips, collapses, creep or flows is seen, a separate coefficient has been applied.

1.8 Peat Landslide Hazard and Risk Assessment

A preliminary peat risk assessment has been undertaken for the Site. To further quantify this initial assessment, analysis of the terrain at Site utilising GIS has been undertaken to analyse slopes and gradients. This data has been combined with site specific peat depth data to assess peat slide risk at the Site.

The method of risk and hazard assessment has been developed with reference to the Scottish Guidance. Key factors which may influence the stability of the peat deposits have been identified leading to an assessment of the RISK of instability. The degree of RISK is calculated by the **likelihood of an event x effect**.

The potential impact of any instability was then considered for identified potential receptors. Scores were attributed to the key factors that have the greatest influence on peat stability. Hazard scores were determined, which, when combined with an assessment of vulnerability of potential targets, were developed into a HAZARD RANKING, based on **Hazard x Exposure**.

The Risk Ranking used for the Site uses the following nomenclature (**Table 1-3**).

Table 1-3
Coefficients for Peat Thickness and Ground Conditions

Ground Conditions	Ground Condition Coefficients
Peaty or organic soil (<0.5 m)	1
Thin Peat (0.5 – 1.0 m)	2
Thick Peat (>1.0 m)	3*
Slips /collapses / creep / flows	8

*Note that thicker peat occurs in areas of shallow gradients and records indicate that thick peat does not occur on the steeper gradients.

1.9 Substrate

As noted above, most failures in thin peat layers occur at the interface with the underlying substrate; the nature of the substrate has a large influence on the probable level of stability (see **Table 1-4**).

Where sand and/or gravel (derived from glacial till) form the substrate, the effective strength of the interface can be good with comparatively high friction values. Under these conditions, failure is likely to occur in a zone within the peat, just above the interface. Further factors are necessary to cause a failure of this nature (increased pore pressures within the peat) and occurrence of such events is rare.

Where clay forms the interface, there is likely to be a significant zone of softening in the clay (due to saturation at low normal stresses, poor or non-existent vertical drainage and the effect of organic acids), resulting in either very low undrained shear strength or low effective shear strength parameters. The result is that potential shearing could occur either in the peat, on the interface or in the clay; all three possibilities have been documented in the past.

A rock substrate provides a high strength stratum, however, the rock surface can be smooth, and, depending on the dip orientation of the strata, it can provide a very weak interface. For these reasons, at this stage, a rock interface has been given the same risk rating as clay.

Table 1-4
Coefficients for Substrate

Substrate Conditions	Substrate Coefficients
Sand/gravel	1
Clay	2
Rock	2
Not proven	3

Substrate Conditions	Substrate Coefficients
Slip material (Existing materials)	5

If the overall thickness of the peat had not been proven, the risk associated with the significant thickness and the unknown substrate would have been given a high rating to accommodate the unknown factors.

1.10 Peat Landslide Probability

The probability of a peat slide (score) was derived by multiplying the coefficients for the four key factors (with historic instability as 0) identified in the above paragraphs, which used together produce a ranking which is a measure of the likelihood of peat instability, and this enables potential areas of concern to be highlighted.

For the stability risk assessment, the following probability classes for a peat landslide were applied, as shown in **Table 1.5**.

Table 1-5
Stability Risk Ranking

Probability of a peat landslide	Potential Stability Risk (Pre-Mitigation)	Action
<5	Negligible	No mitigation action required
5 - <15	Unlikely/low	As for negligible condition plus development of a site-specific construction and management plan for peat areas
15 - <31	Likely/medium	As for Low condition plus may require mitigation to improve site conditions.
>31	Probable/high	Unacceptable level of risk, the area should be avoided. If unavoidable, detailed investigation and quantitative assessment required to determine stability and sensitivity to minor changes in strength and groundwater regime combined with long term monitoring.
>51	Almost certain/very high	Unacceptable level of risk, the area should be avoided.

The ranking system outlined above is consistent with that proposed in the SG Guidance[19] however the system adopted here incorporates four inputs compared to three in the guidance, with the potential impact of substrate added to this assessment.

[19] Scottish Government (April 2017) Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments (Second Edition).

1.10.1 Summary of Peat Landslide Risk Assessment

The main activities which have the potential to impact on the peat resource are the construction of access tracks, underground cabling and CSE compounds, and the construction of pole / tower foundations.

The cabling and CSE compounds have been identified to be in areas of low stability risk. Many of the tracks are existing and pose no stability risk, and where new tracks are proposed these are in areas of low stability risk, located mainly on flat lying ground. Stability risk associated with construction activity of the towers and poles has been assessed at each location where deeper peat has been identified, as set out in the paragraphs below.

The probability of a landslide identified 382 proposed towers or wood poles at a location with greater than 0.5 m peat present. The remainder of the towers / wood poles have less than 0.5 m of peat and therefore pose no risk. This data has been derived from **Annex A** which summarises all the peat probes undertaken across the Site.

Of the wood poles / towers located in peat >0.5 m deep, the following stability risk ranking (pre mitigation) has been identified.

- Negligible probability at 54 wood pole / tower locations;
- Low probability at 216 wood pole / tower locations;
- Medium probability at 91 wood pole / tower locations; and
- High/ probability at 21 of the wood pole /tower locations.

Table 1-6 presents an interpretation for each proposed pole / tower location assessed to have medium or high-risk probability of peat instability based on the multiplication of the risk coefficients discussed in the paragraphs above.

The interpreted probability of peat instability for each proposed pole / tower (based on nearest peat probe location) is summarised as set out below, and indicates areas of concern where further attention or micrositing is required.

- Where peat depth is between 0.5 m -1 m deep and is considered a medium risk, this location is accepted as constructable without further work or assessment and is flagged as Medium Risk (Light Green).
- Where the peat is greater than 1 m deep and has a gradient less than 8 degrees, this location is accepted as constructable without further work or assessment and is flagged as Medium Risk (Light Green).
- Where the peat is greater than 1 m deep and has a gradient greater than 8 degrees, this location is accepted as constructable but may warrant further attention, such as micrositing, and is flagged as Medium Risk (Yellow).
- Where the peat is greater than 1 m deep and has a gradient greater than 12 degrees, this location is accepted as constructable but warrants further attention, possibly micrositing, and is flagged as High Risk (Red).

Table 1-6
Instability Risk Ranking at each proposed wood pole / tower within Section 0-6 (excluding the Alternative Alignment in Section 3) with peat greater than 0.5 m deep (derived from Annex A, which includes the entire peat probing data set)

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
0	AD212	127708	847272	1.48	5.0	Medium	Yes	less than 8^0 degrees

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
0	AD205	127729	847821	0.85	6.6	Medium	Yes	<1m easily excavated
0	AD199	127701	848298	0.90	5.4	Medium	Yes	<1m easily excavated
0	AD198	127696	848377	0.69	5.7	Medium	Yes	<1m easily excavated
0	AD195	127683	848615	0.86	7.2	Medium	Yes	<1m easily excavated
0	AD180	127819	849748	0.50	11.4	Medium	Yes	<1m easily excavated
0	AD179	127844	849819	0.52	10.5	Medium	Yes	<1m easily excavated
0	AD178	127840	849896	0.61	10.5	Medium	Yes	<1m easily excavated
0	AD177	127837	849970	0.60	10.7	Medium	Yes	<1m easily excavated
0	AD175	127830	850123	0.70	9.4	Medium	Yes	<1m easily excavated
0	AD173	127822	850280	0.74	12.1	Medium	Yes	<1m easily excavated
0	AD169	127824	850580	0.60	10.2	Medium	Yes	<1m easily excavated
0	AD168	127837	850647	0.68	9.2	Medium	Yes	<1m easily excavated
0	AD167	127850	850714	1.47	8.6	Medium	Yes	Localised peaty area by river may require micrositing
0	AD166	127901	850777	1.71	4.4	Medium	Yes	less than 8^0 degrees
0	AD164	128036	850855	1.65	5.2	Medium	Yes	less than 8^0 degrees
0	AD157	128512	851140	0.70	4.6	Medium	Yes	<1m easily excavated
0	AD155	128505	851285	0.85	6.3	Medium	Yes	<1m easily excavated
0	AD144	127972	851949	0.57	10.7	Medium	Yes	<1m easily excavated
0	AD138	127887	852424	0.80	5.1	Medium	Yes	<1m easily excavated
0	AD136	127858	852583	0.66	8.4	Medium	Yes	<1m easily excavated
0	AD134	127830	852741	0.61	9.0	Medium	Yes	<1m easily excavated

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
0	AD130	127773	853058	0.78	8.0	Medium	Yes	<1m easily excavated
0	AD128	127744	853217	1.13	6.7	Medium	Yes	less than 8^0 degrees
0	AD127	127730	853296	0.83	7.1	Medium	Yes	<1m easily excavated
0	AD125	127702	853454	0.53	10.3	Medium	Yes	<1m easily excavated
0	AD123	127673	853613	0.75	12.3	Medium	Yes	<1m easily excavated
0	AD122	127659	853692	0.57	12.6	Medium	Yes	<1m easily excavated
0	AD121	127645	853771	0.72	10.6	Medium	Yes	<1m easily excavated
0	AD120	127631	853850	0.69	8.3	Medium	Yes	<1m easily excavated
0	AD119	127616	853930	0.61	8.3	Medium	Yes	<1m easily excavated
0	AD112	127431	854465	0.55	14.3	Medium	Yes	<1m easily excavated
0	AD109	127412	854703	0.83	12.2	Medium	Yes	<1m easily excavated
0	AD105	127386	855027	0.55	12.4	Medium	Yes	<1m easily excavated
0	AD96	127412	855737	0.50	16.0	Medium	Yes	<1m easily excavated
0	AD77	126956	857087	0.53	7.6	Medium	Yes	<1m easily excavated
0	AD52	126496	858891	1.14	8.3	Medium	Yes	Deeper peat on steep slope should be assessed
0	DE106	134416	843971	1.89	10.0	Medium	Yes	Deeper peat on steep slope should be assessed
0	DE35	129789	845500	1.27	4.8	Medium	Yes	less than 8^0 degrees
0	DE34	129706	845507	1.30	4.3	Medium	Yes	less than 8^0 degrees
0	DE30	129375	845536	0.87	6.6	Medium	Yes	<1m easily excavated
0	DE28	129257	845645	1.75	4.8	Medium	Yes	less than 8^0 degrees

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
0	DE27	129199	845699	1.79	5.6	Medium	Yes	less than 8^0 degrees
0	DE26	129140	845753	1.30	6.6	Medium	Yes	less than 8^0 degrees
0	DE6	127962	846844	0.87	4.3	Medium	Yes	less than 8^0 degrees
1	BE61	144102	837995	3.15	13.5	High	Yes	Deeper peat on steep slope should be assessed
2	BE16	159318	826300	0.92	10.3	Medium	Yes	<1m easily excavated
4	BF123	184064	819209	0.60	10.7	High	Yes	<1m easily excavated
4	BF198	197247	804095	2.30	16.7	High	Yes	Deeper peat on steep slope should be assessed
4	BF112	184758	817602	1.90	6.1	Medium	Yes	Deeper peat on moderate slope should be assessed
4	BF224	198155	803808	0.60	5.9	High	Yes	<1m easily excavated
4	BF193	194259	807920	0.70	12.4	High	Yes	<1m easily excavated
4	BF158	191331	809819	0.70	13.3	High	Yes	<1m easily excavated
4	BF115	182978	820612	0.80	5.9	High	Yes	<1m easily excavated
4	BF184	195937	806361	0.70	11.3	High	Yes	<1m easily excavated
4	BF210	199894	803527	0.70	13.0	Medium	Yes	<1m easily excavated
4	BF93	182404	821061	0.90	9.5	Medium	Yes	<1m easily excavated
4	BF98	183208	820261	0.90	6.9	Medium	Yes	<1m easily excavated
4	BF91	181931	821314	1.90	13.4	High	Yes	Deeper peat on steep slope should be assessed
4	BF111	184662	817763	2.20	21.5	High	Yes	Deeper peat on steep slope should be assessed

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
4	BF211	200147	803533	0.65	15.0	Medium	Yes	<1m easily excavated
4	BF121	186099	816180	1.50	17.4	High	Yes	Deeper peat on steep slope should be assessed
4	BF173	194259	807920	2.50	17.3	High	Yes	Deeper peat on steep slope should be assessed
4	BF107	184470	818652	1.10	21.2	High	Yes	Deeper peat on steep slope should be assessed
4	BF200	197552	803865	0.60	8.3	Medium	Yes	<1m easily excavated
4	BF191	195946	804932	0.80	18.1	Medium	Yes	<1m easily excavated
4	BF83	180269	822151	3.70	12.2	High	Yes	Deeper peat on steep slope should be assessed
4	BF203	195692	806806	2.25	12.6	High	Yes	Deeper peat on steep slope should be assessed
4	BF104	184064	819209	1.80	12.9	High	Yes	Deeper peat on steep slope should be assessed
4	BF208	199358	803655	1.60	15.6	High	Yes	Deeper peat on steep slope should be assessed
4	BF205	198602	803795	0.95	17.0	Medium	Yes	<1m easily excavated
4	BF235	204810	802193	0.80	20.2	Medium	Yes	<1m easily excavated
4	BF95	182830	820762	1.00	20.5	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF137	188050	812938	1.30	17.6	High	Yes	Deeper peat on steep slope should be assessed

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
4	BF140	188227	812241	0.90	16.6	Medium	Yes	<1m easily excavated
4	BF105	184200	819054	1.50	8.8	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF97	183038	820430	0.80	29.3	Medium	Yes	<1m easily excavated
4	BF226	203112	803095	1.70	14.9	High	Yes	Deeper peat on steep slope should be assessed
4	BF200	197552	803865	0.80	26.5	Medium	Yes	<1m easily excavated
4	BF181	191780	809580	2.50	20.1	High	Yes	Deeper peat on steep slope should be assessed
4	BF117	185526	816763	1.00	15.5	Medium	Yes	<1m easily excavated
4	BF229	203723	802692	0.60	10.6	Medium	Yes	<1m easily excavated
4	BF203	198155	803808	1.90	19.3	High	Yes	Deeper peat on steep slope should be assessed
4	BF189	195821	805372	0.65	21.1	Medium	Yes	<1m easily excavated
4	BF152	190258	810768	0.80	13.1	Medium	Yes	<1m easily excavated
4	BF218	201689	804048	1.10	10.5	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF230	203965	802533	0.60	14.3	Medium	Yes	<1m easily excavated
4	BF171	193969	808104	1.00	11.3	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF90	181741	821415	1.65	11.9	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF153	190442	810520	0.60	11.5	Medium	Yes	<1m easily excavated

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
4	BF234	204544	802250	0.65	5.5	Medium	Yes	<1m easily excavated
4	BF119	185842	816448	2.40	7.4	Medium	Yes	less than 8^{0} degrees
4	BF118	185712	816577	1.20	16.0	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF225	202830	803200	2.80	20.5	High	Yes	Deeper peat on steep slope should be assessed
4	BF170	193745	808272	1.30	15.3	High	Yes	Deeper peat on steep slope should be assessed
4	BF122	186155	816115	0.90	18.9	Medium	Yes	<1m easily excavated
4	BF185	195902	806186	3.20	17.6	High	Yes	Deeper peat on steep slope should be assessed
4	BF157	191127	809928	0.90	14.2	Medium	Yes	<1m easily excavated
4	BF221	202107	803858	1.20	22.3	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF194	196315	804280	0.75	15.0	Medium	Yes	<1m easily excavated
4	BF120	183631	819757	0.80	16.4	Medium	Yes	<1m easily excavated
4	BF228	203484	802850	0.70	17.1	Medium	Yes	<1m easily excavated
4	BF239	205753	801960	1.10	12.2	Medium	Yes	Deeper peat on steep slope should be assessed
4	BF178	195160	807272	0.60	23.7	Medium	Yes	<1m easily excavated
5	BF310	223086	802669	0.90	12.4	High	Yes	<1m easily excavated
4	BF321	225675	802931	0.80	13.0	Medium	Yes	<1m easily excavated
5	BF266	212451	801907	0.60	16.3	Medium	Yes	<1m easily excavated

Section	Tower / Pole No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
5	BF289	217929	802034	0.60	12.1	Medium	Yes	<1m easily excavated
5	BF246	207466	802510	0.70	4.4	Medium	Yes	<1m easily excavated
5	BF296	219501	802514	1.60	16.2	Medium	Yes	Deeper peat on steep slope should be assessed

Table 1-7
Instability Risk Ranking at each tower located along the Alternative Alignment within Section 3 with peat greater than 0.5 m deep (derived from Annex A, which includes the entire peat probing data set)

Section	Tower No.	Grid Coordinates		Peat Thickness (m)	Slope	Probability of Peat Instability	Acceptable Location	Comments
3 (Alternative Alignment)	BF57	175685	820525	0.58	15.7	Medium	Yes	<1m easily excavated
3 (Alternative Alignment)	BF48	17333	821209	1.08	10.8	Medium	Yes	Deeper peat on steep slope should be assessed

As can be seen from **Table 1.6**, there are 112 'medium' and 'high'-risk sites. Of these, SLR have highlighted 33 sites which may warrant additional assessment. The remainder of the proposed pole / tower positions fall within the 'negligible' or 'low' risk classification, which amounts to 270 localities. A further 472 locations have no risk. There are no major or extensive areas where significant potential risk is likely across the Site.

From west to east, the areas where new access tracks are proposed to be located on deeper peat are on flatter terrains, i.e., in Sections 1, 2, 3 and 6. On the steeper areas within Sections 3 , 4 and 5, the steepness of slopes increase risk factors, but the peat is much thinner and overall risk from peat slides is significantly reduced. The underground cabling with Sections 2 and 6 are proposed to be located on shallow soils, with minimal peat and negligible to low stability risk.

1.11 Construction Activity and Peat Management

The main activities which have the potential to impact on the peat resource are the construction of access tracks, underground cabling and CSE compounds, and the construction of pole / tower foundations. Construction activities are described in **Volume 1, Chapter 3: Project Description** of the EIA Report. This part of the Appendix outlines the general approach that will be taken by the Principal Contractor to minimise disturbance of peat during the construction period.

The Proposed Development will use the LoD specified to avoid areas of potential peat instability wherever possible. Specific measures proposed to minimise the potential effects from peat slide and on peat as a resource are described below.

- Micrositing will be used during the detailed design and construction phases to further avoid areas of peat or other high-risk areas. This would be undertaken under the direction of an environmental advisor and geotechnical engineer (as necessary).
- Tracks will be microsited to avoid the need for localised cut and fill, particularly on convex slopes.
- Underground cabling is on areas with minimal peat or very isolated areas of peat and hence negligible to low peat slide risk. A few localised areas indicate higher risk but these will not impact stability due to the limited extent. The cabling routes will be restored immediately after construction to minimise risk.
- Foundation design of proposed towers will consider the use of alternatives to pad and column foundations in areas of loose or deep superficial deposits (including peat) e.g., piled solutions.
- Geotechnical supervision will be provided throughout the construction phase.
- A Geotechnical Risk Register will be completed as part of the design phase.
- Concentrated loads, such as excavated material placed on the slope, create the single most adverse negative short-term effect on the stability of a slope. Accordingly, during the construction phase, all excavated materials will be removed to temporary storage mounds positioned at safe slope gradients and certified by a geotechnical engineer.
- Loading associated with the construction of floating tracks may lead to unstable ground conditions. Accordingly, all tracks will be, as far as possible, constructed under geotechnical supervision and monitored during and after construction.
- Excavation of the slope for foundations or for excavated tracks may remove toe support and increase potential for ground movements. The earthworks and any excavation will be designed and undertaken in such a way as to avoid any excavation of toe support material. The excavation of any temporary slopes will be fully designed.
- Disturbance to the natural drainage system may increase potential for peat instability. Therefore, the design of any new drainage will be undertaken to ensure no adverse loading is placed on areas of marginal peat stability.
- Since peat sliding invariably involves increased pore water pressures, it follows that robust drainage plans and engineering control of water during the development should result in a significant overall reduction in the risk of peat instability.

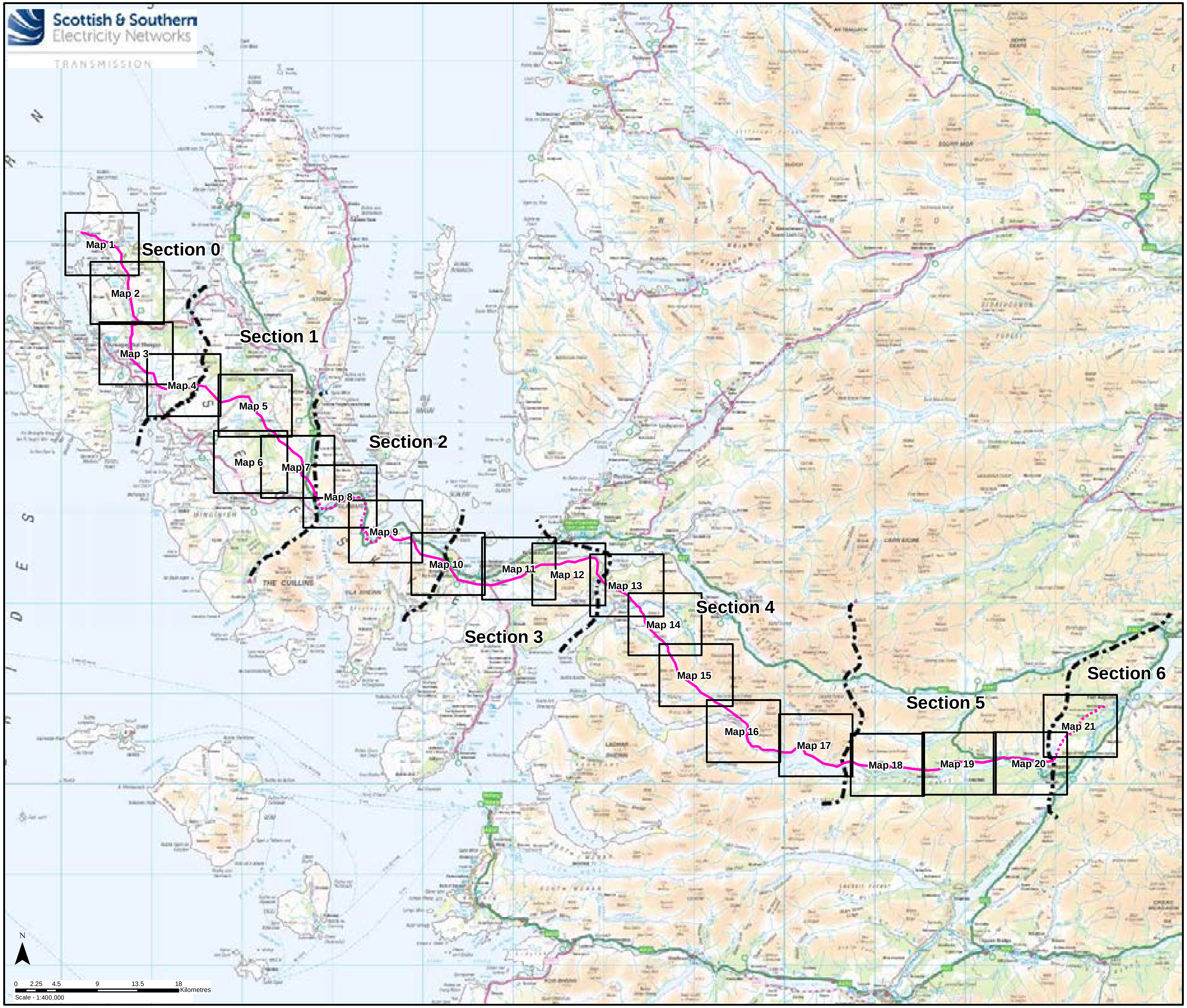
1.12 Conclusion

The site has been assessed for potential hazards associated with peat instability. A peat probing exercise at over 5,800 locations and specifically at 854 tower or wood pole locations, as well as underground cabling and CSE locations in areas of identified peaty soil/peat, was used to determine the thickness thereof. Of the 854 total pole and tower locations, 382 had peat (> 0.5 m deep) present, of these, medium risk and high-risk sites were identified at 112 locations. By further review of the data, the locations were screened to assess risk and of these only 11 medium risk sites and 21 high risk sites were identified which should be assessed prior to construction by a qualified geotechnical engineer. The remainder were all deemed to be suitable for mitigation by construction design, as the assessment was influenced by either deep peat on a flatter slope or thinner peat on a steep slope.

The overall conclusion regarding peat stability is that there is negligible to low risk of peat instability over most of the Proposed Development although some limited areas of medium and high stability risk have been identified. Subject to the employment of appropriate mitigation measures, all these areas can be considered constructable with minimal peat slide risk, as the area impacted by construction will be limited, extent of excavation and in most instances the peat will be used to restore the Site immediately.

FIGURE V2-7.2.1 (MAP 1-21)

Infrastructure on peat greater than 0.5m deep located along entire route with peat slide risk



Key

- Proposed OHL Alignment
- Proposed Underground Cable

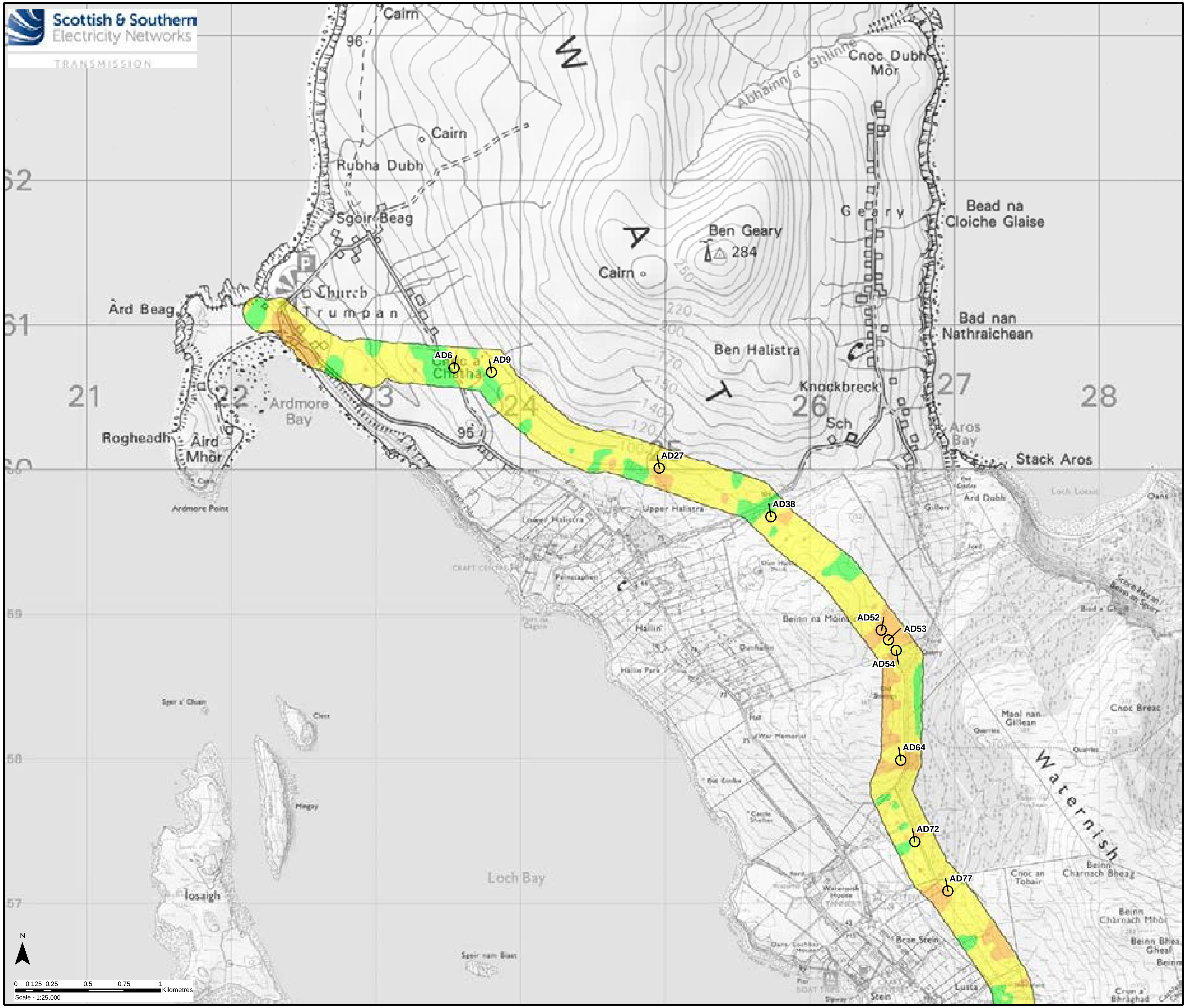
Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Infrastructure with Slide Risk
Overview

Drawn by: AA Date: 07/09/2022

Drawing: 04707.00020.0113.0



Key

○ Proposed Wood Pole (H Pole) Section 0 on Peat > 0.5m

Peat Slide Risk

- Negligible
- Low
- Medium
- High

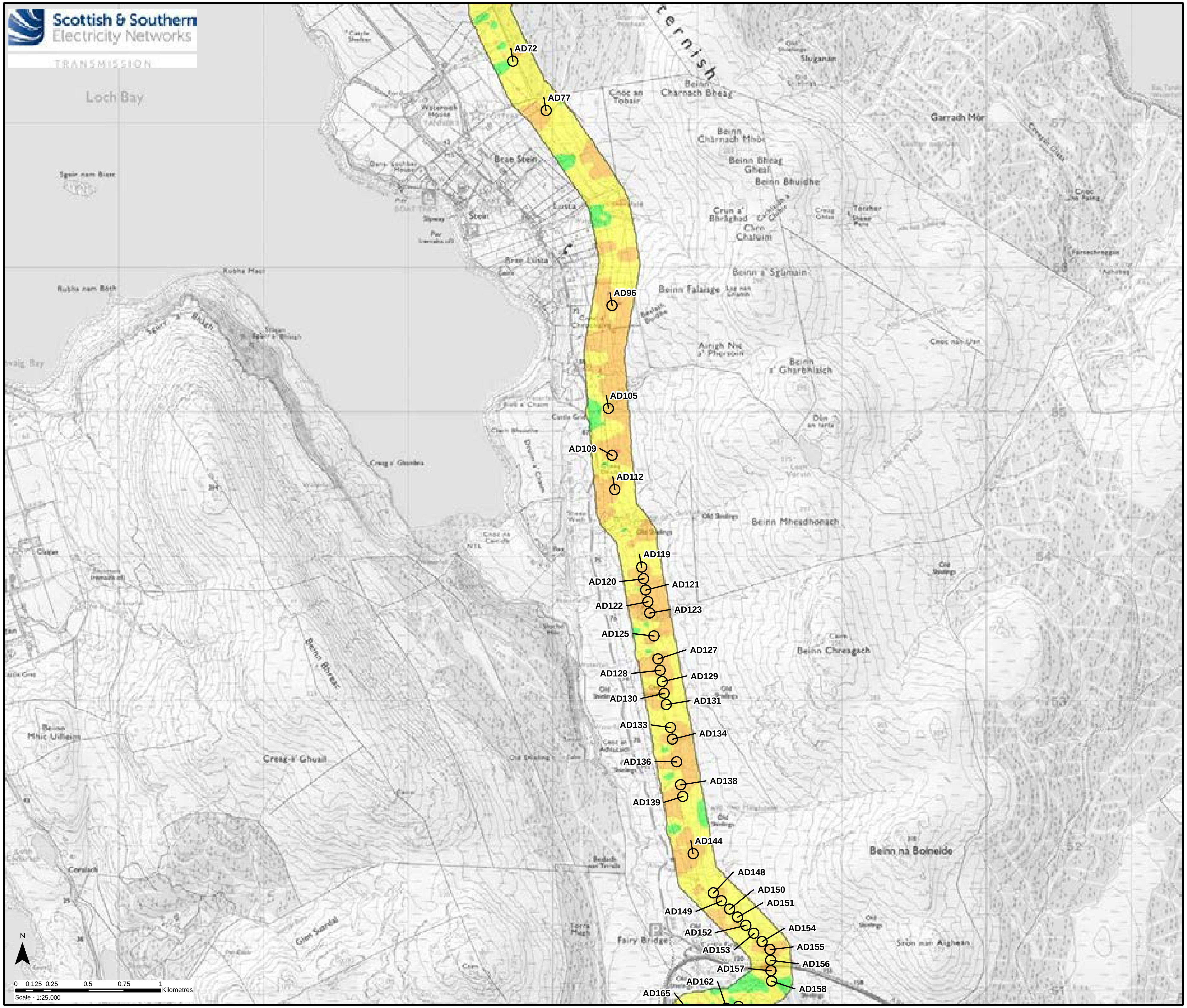
Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Infrastructure with Slide Risk
Map 1 - Section 0

Drawn by: AA Date: 07/09/2022

Drawing: 04707.00020.0113.0



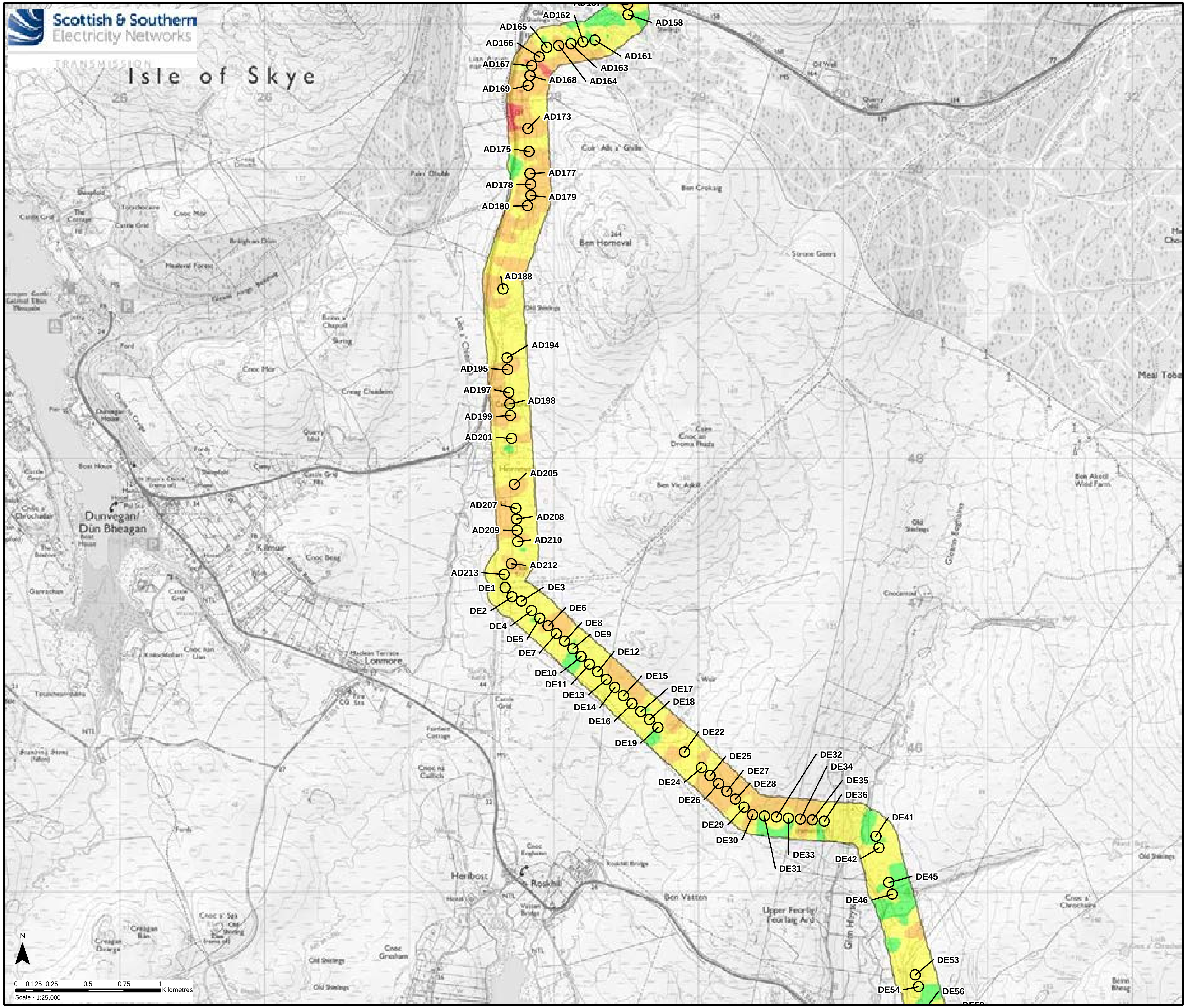
Key

○ Proposed Wood Pole (H Pole) Section 0 on Peat > 0.5m

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 2 - Section 0
Drawn by:	AA
Date:	07/09/2022
Drawing:	04707.00020.0113.0



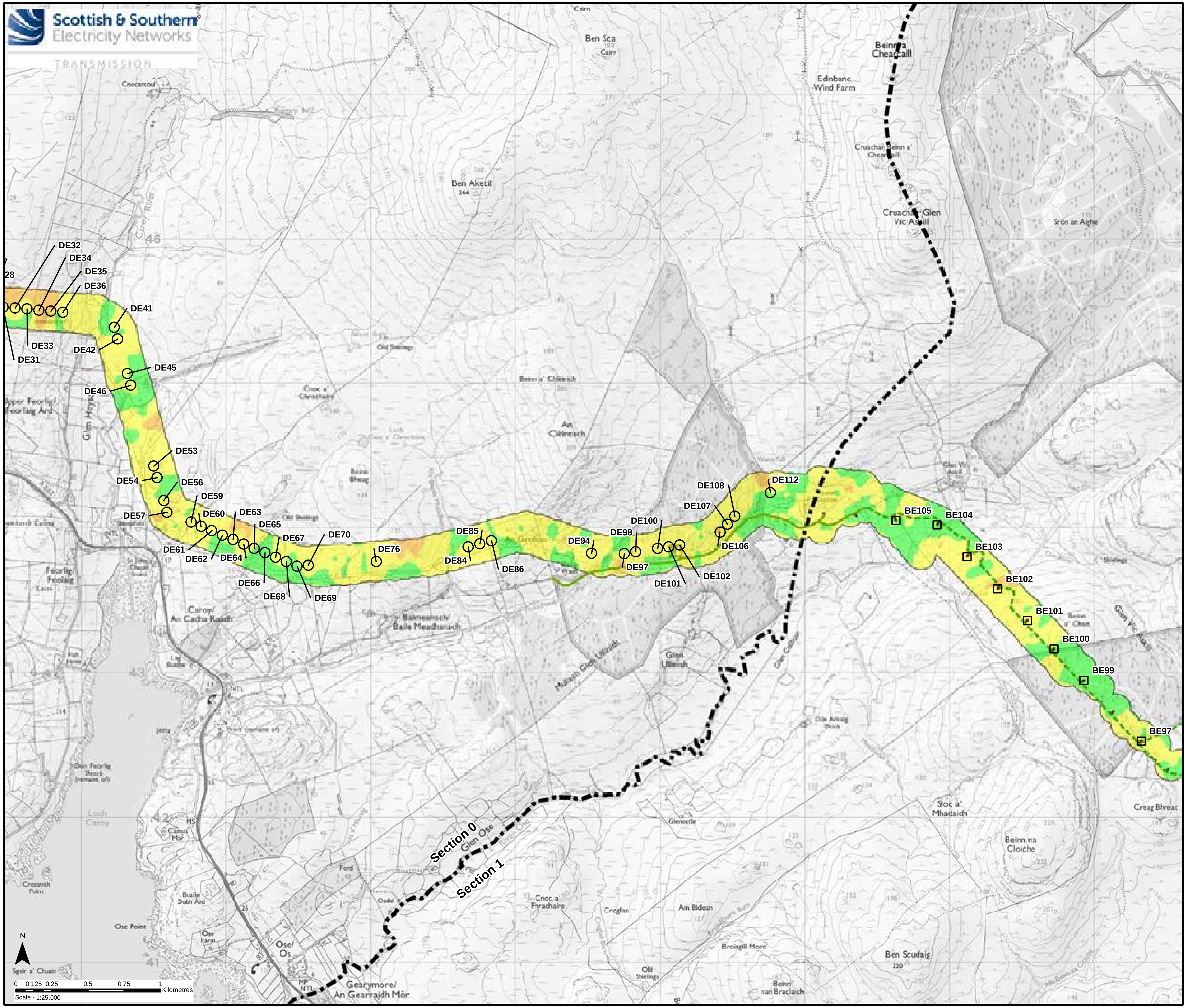
Key

○ Proposed Wood Pole (H Pole) Section 0 on Peat > 0.5m

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 3 - Section 0
Drawn by:	AA
Date:	07/09/2022
Drawing:	04707.00020.0113.0



Key

- ○ Proposed Wood Pole (H Pole) Section 0 on Peat > 0.5m
- □ Proposed Steel Lattice Tower Section 1 on Peat > 0.5m
- Existing Access Track
- New Temporary Access Track
- New Temporary Spur to Towers

Peat Slide Risk

- Negligible
- Low
- Medium

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 4 - Sections 0 & 1
Drawn by:	AA — Date: 07/09/2022
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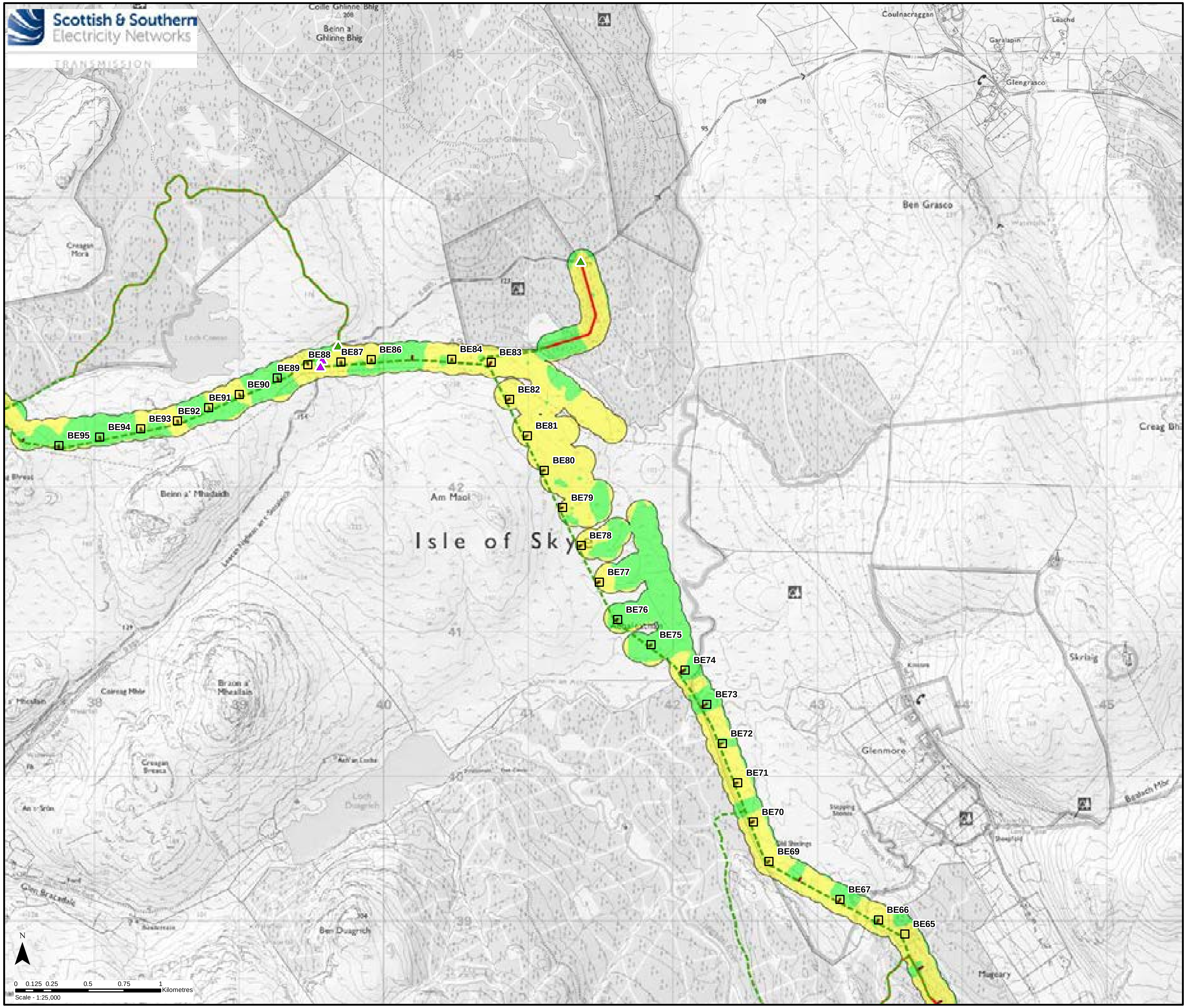

Key

- □ Proposed Steel Lattice Tower Section 1 on Peat > 0.5m
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- ▲ Existing Bellmouth
- ▲ Temporary Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 5 - Section 1
Drawn by:	AA
Date:	07/09/2022
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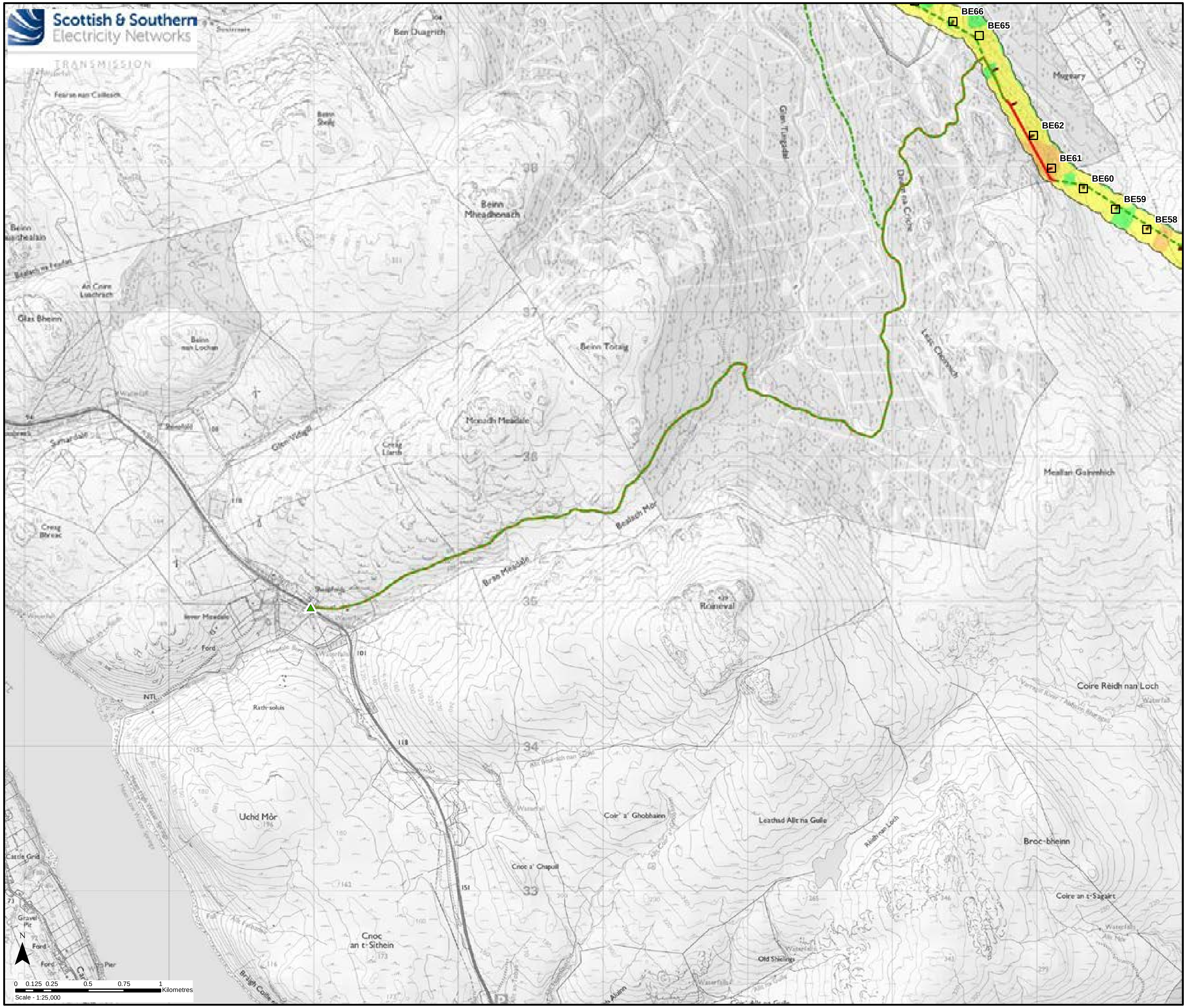


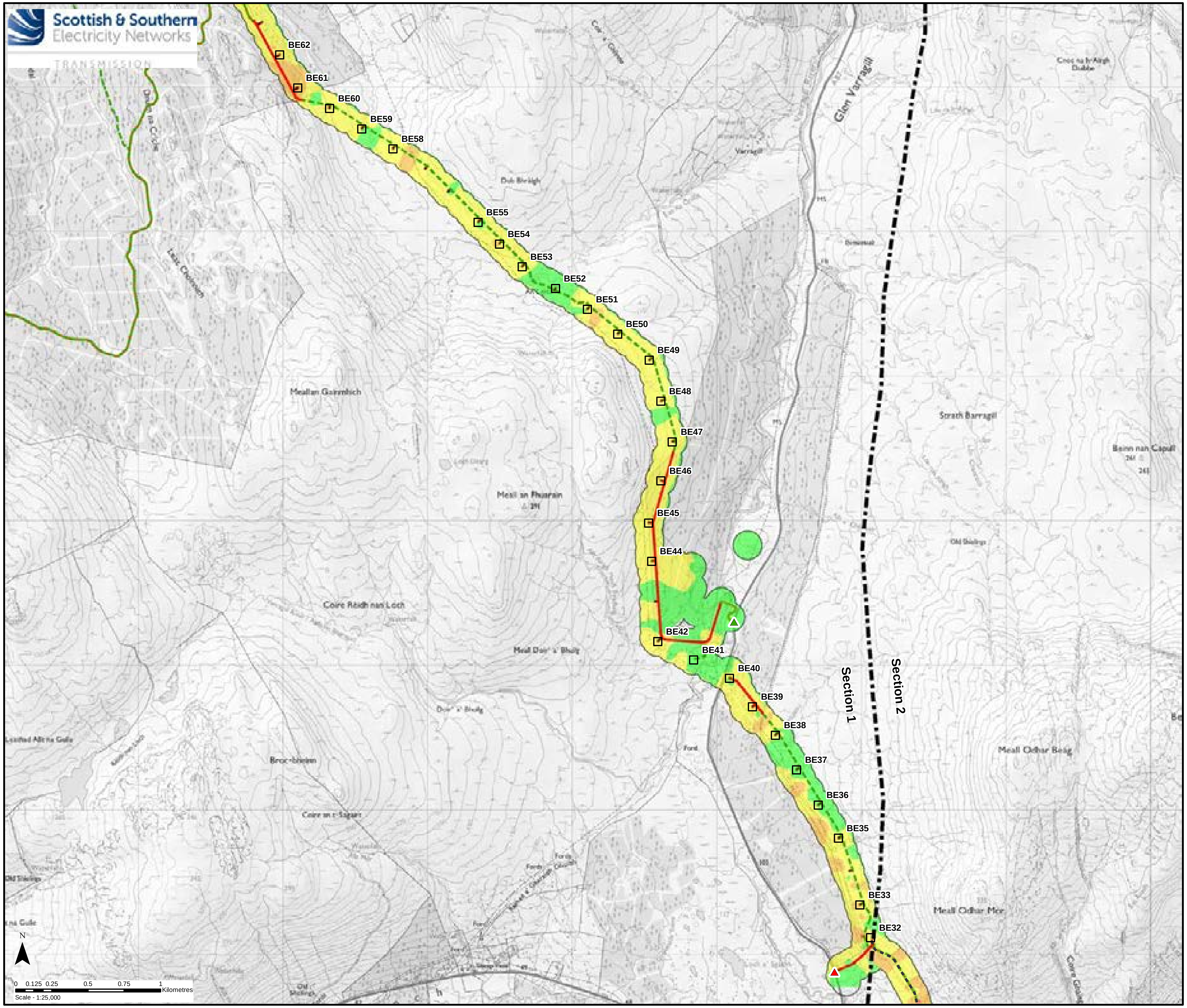
Key

- Proposed Steel Lattice Tower Section 1 on Peat > 0.5m
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 6 - Section 1
Drawn by:	AA — Date: 07/09/2022
Drawing:	04707.00020.0113.0



Key

- Proposed Steel Lattice Tower Section 1 on Peat > 0.5m
- Proposed Underground Cable Section 2
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 7 - Sections 1 & 2
Drawn by:	AA — Date: 07/09/2022
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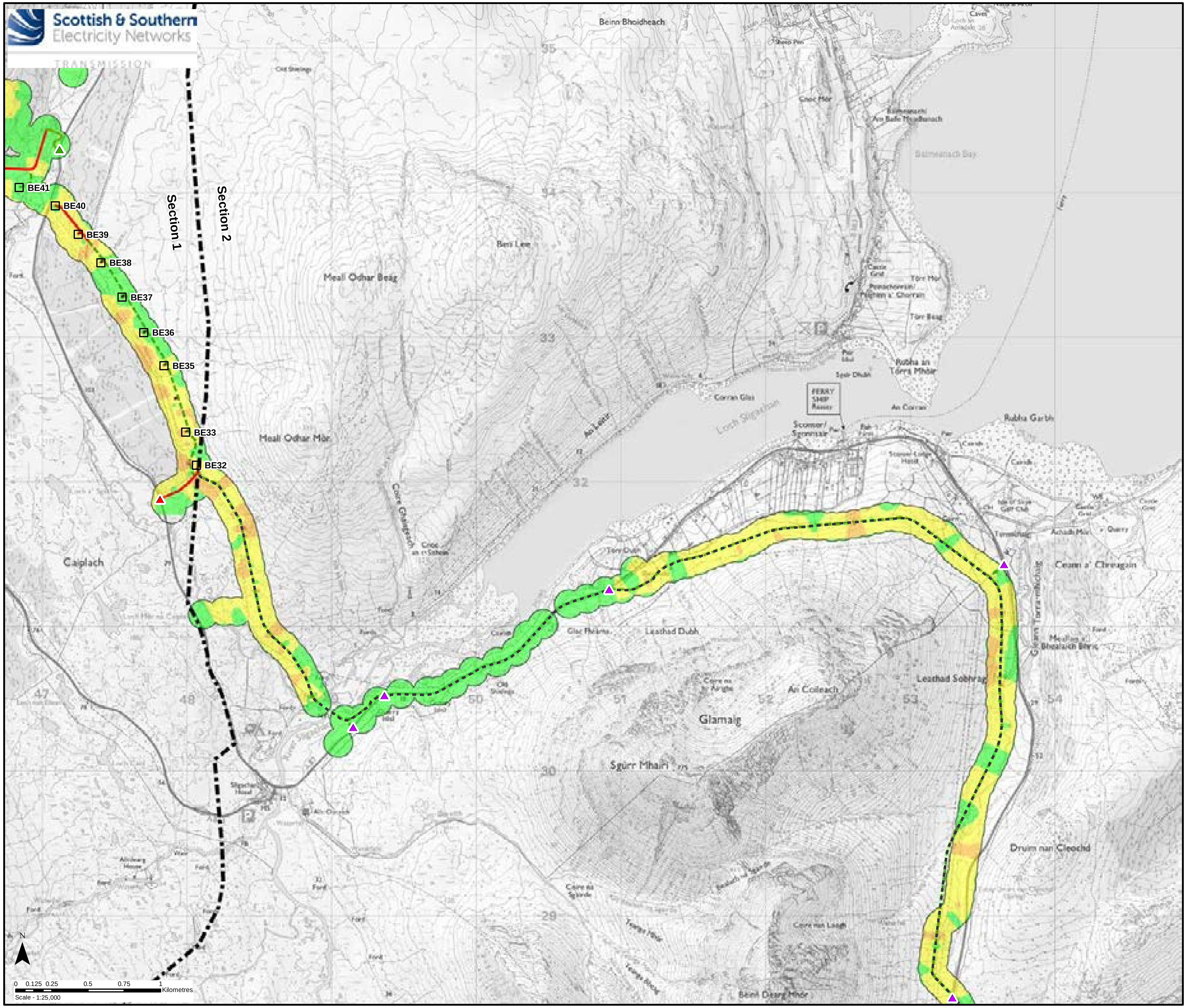


Key

- □ Proposed Steel Lattice Tower Section 1 on Peat > 0.5m
- Proposed Underground Cable Section 2
- Existing Access Track
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium
- High

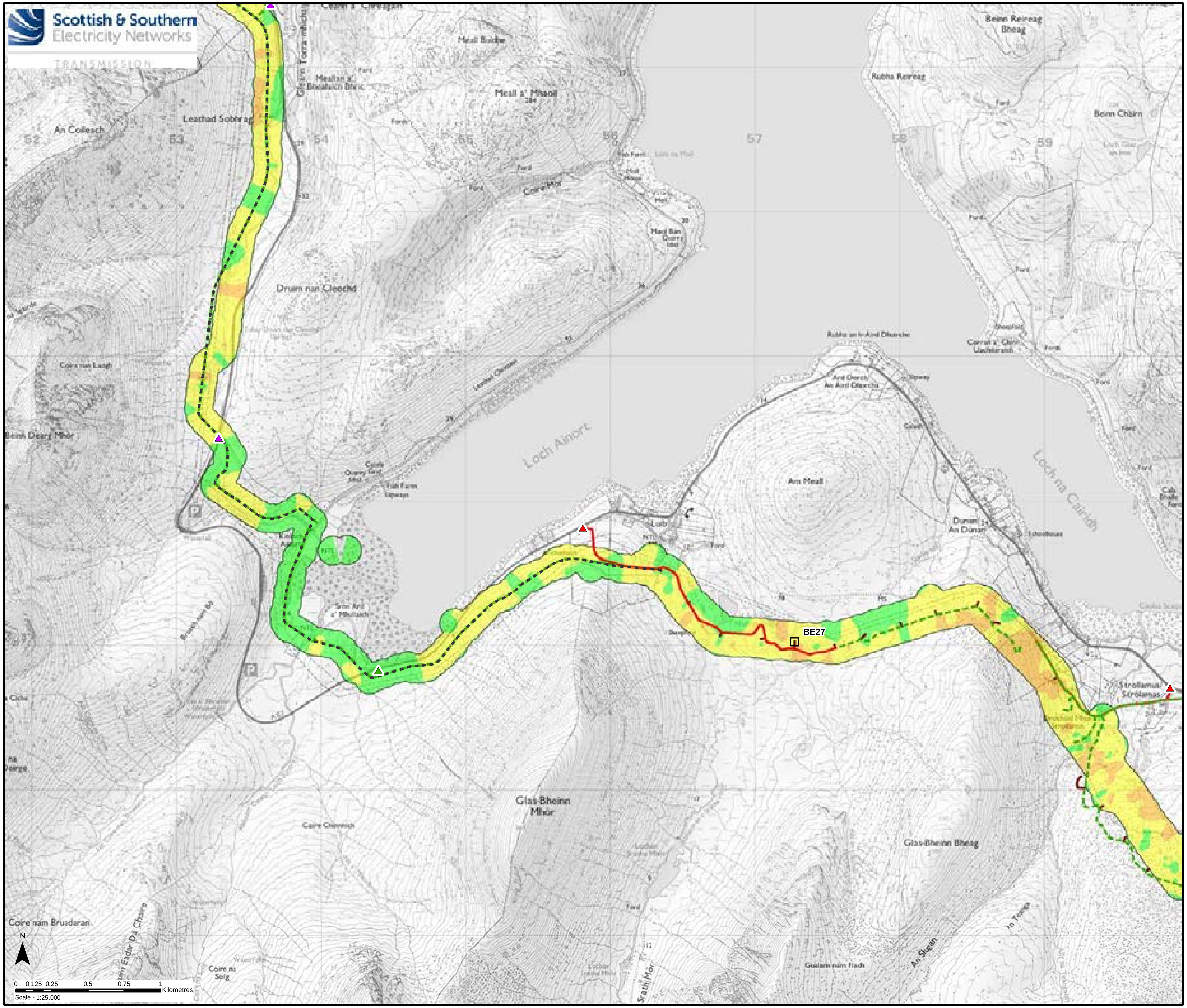
Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Infrastructure with Slide Risk Map 8 - Sections 1 & 2

Drawn by: AA Date: 07/09/2022

Drawing: 04707.00020.0113.0



Key

- Proposed Steel Lattice Tower Section 2 on Peat > 0.5m
- Proposed Underground Cable Section 2
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 9 - Section 2
Drawn by:	AA — Date: 07/09/2022
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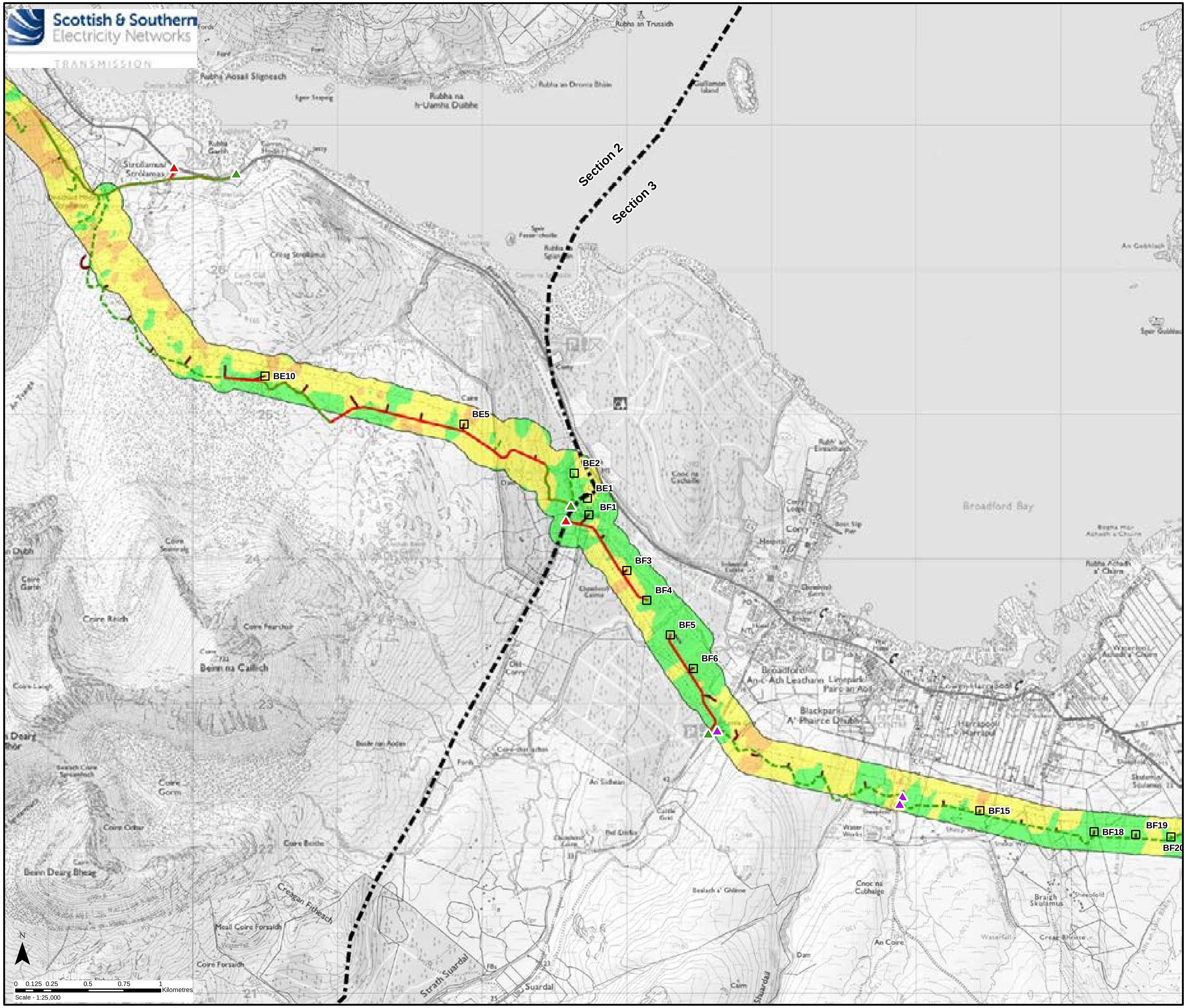

Key

- Proposed Steel Lattice Tower Section 2 on Peat > 0.5m
- Proposed Steel Lattice Tower Section 3 on Peat > 0.5m
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 10 - Sections 2 & 3
Drawn by:	AA — Date: 07/09/2022
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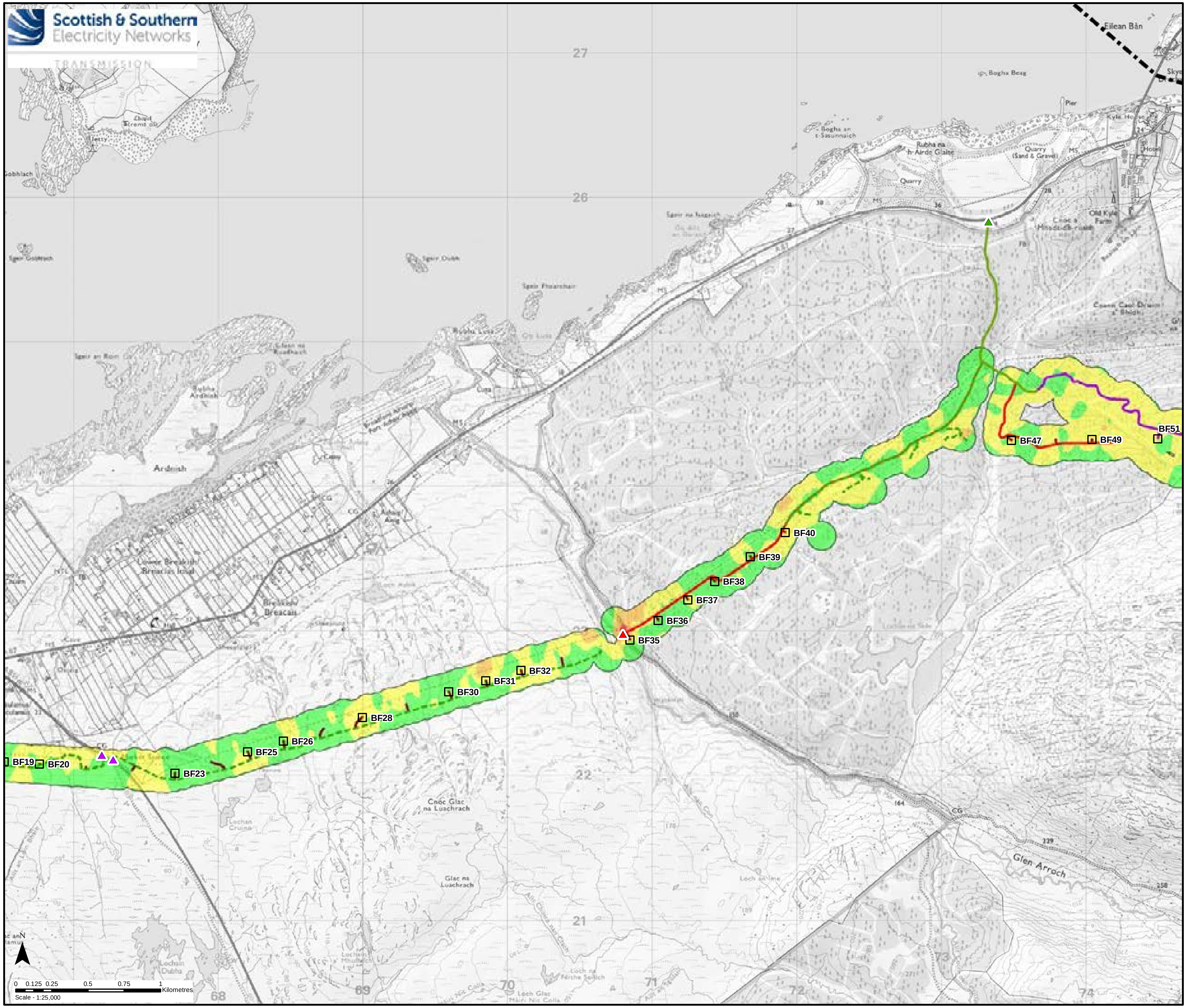

Key

- Proposed Steel Lattice Tower Section 3 on Peat > 0.5m
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (Floating Construction)
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 11 - Section 3
Drawn by:	AA
Date:	07/09/2022
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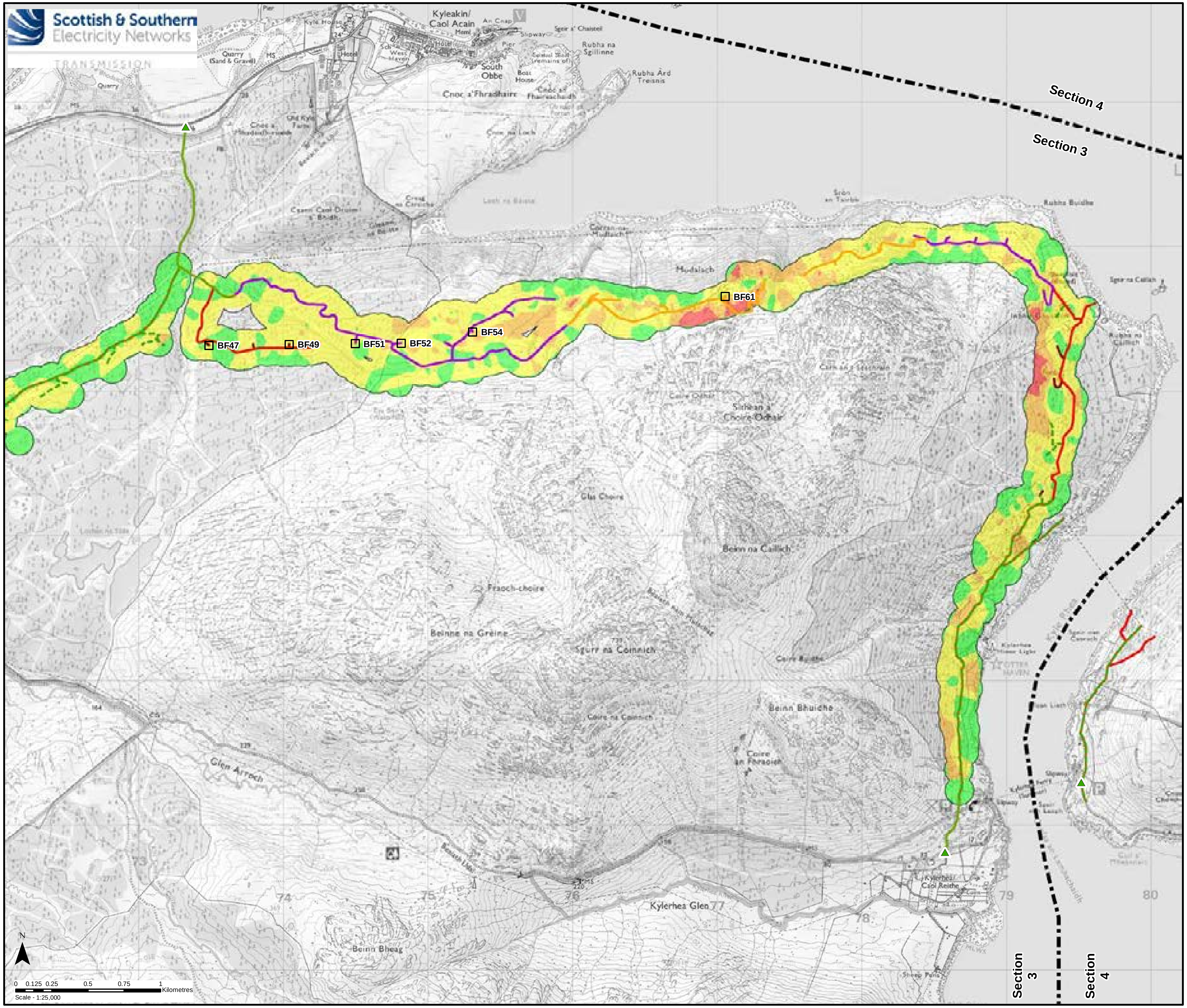

Key

- □ Proposed Steel Lattice Tower Section 3 on Peat > 0.5m
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (Cut / Fill Construction)
- New Permanent Access Track (Floating Construction)
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- ▲ Existing Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 12 - Sections 3 & 4
Drawn by: AA	Date: 07/09/2022
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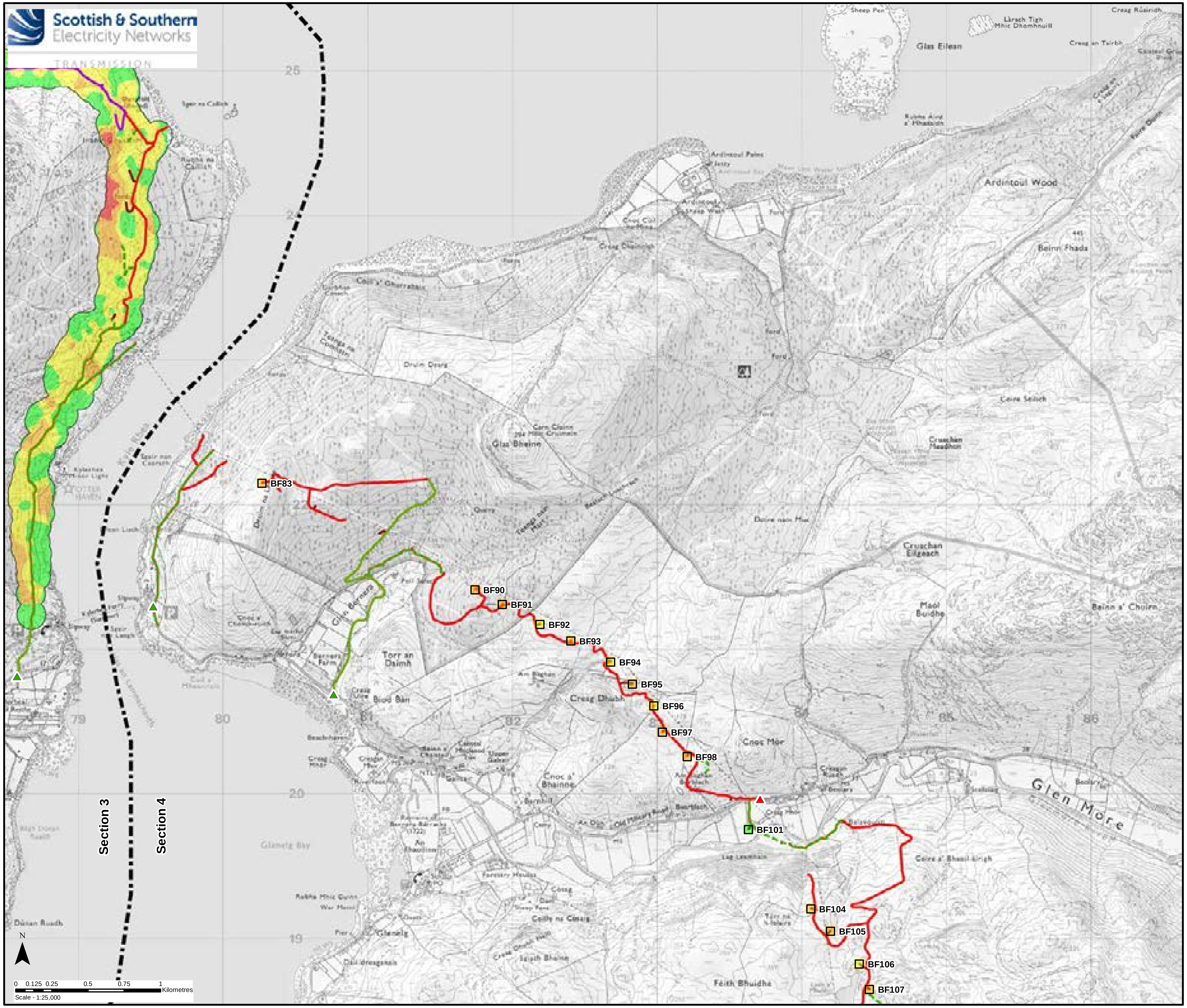

Key

- Proposed Steel Lattice Tower Section 4 on Peat > 0.5m
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (Floating Construction)
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium
- High

Peat Slide Risk (At Tower Location)

- Negligible
- Low
- Medium

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 13 - Sections 3 & 4
Drawn by:	AA
Date:	07/09/2022
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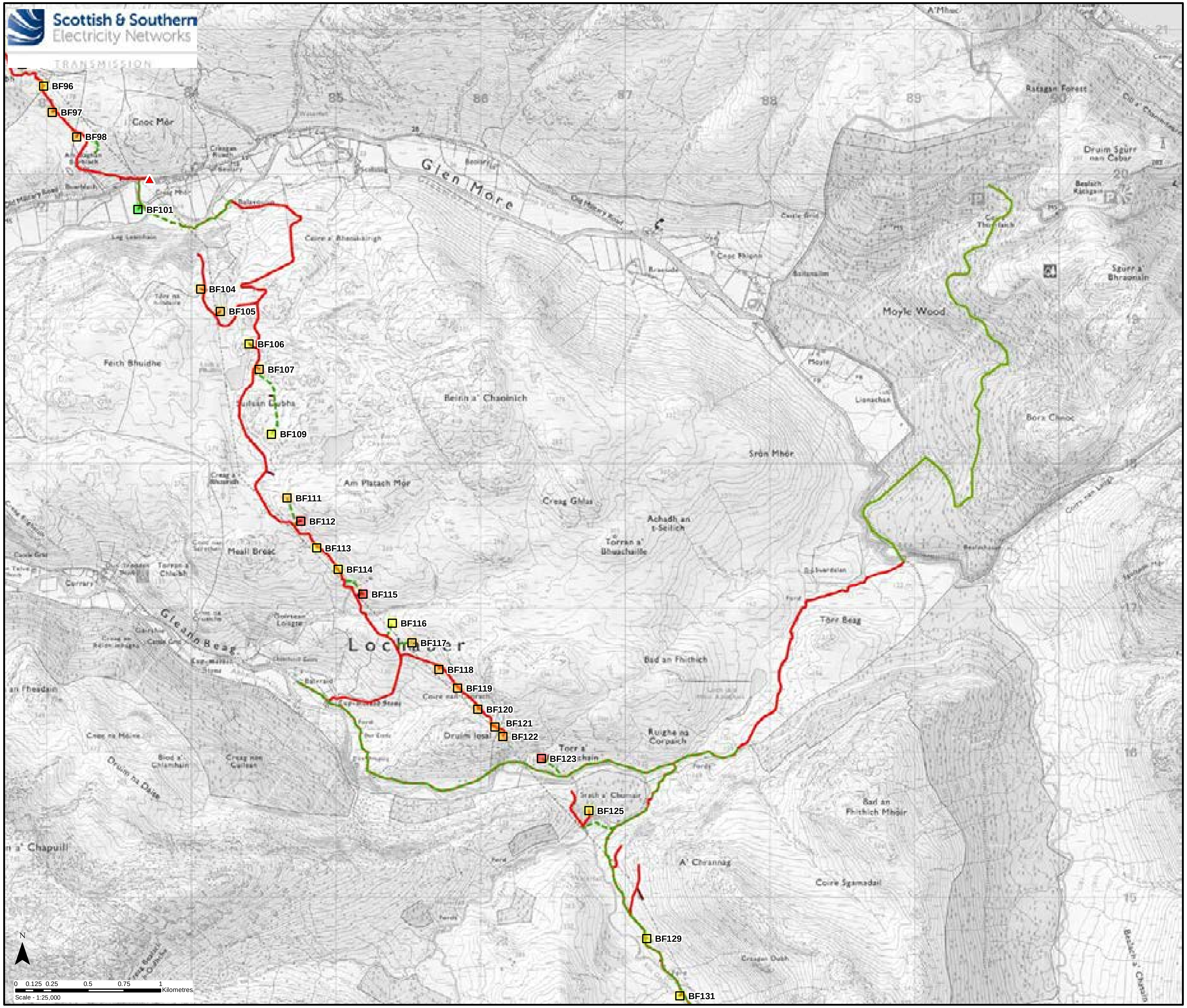


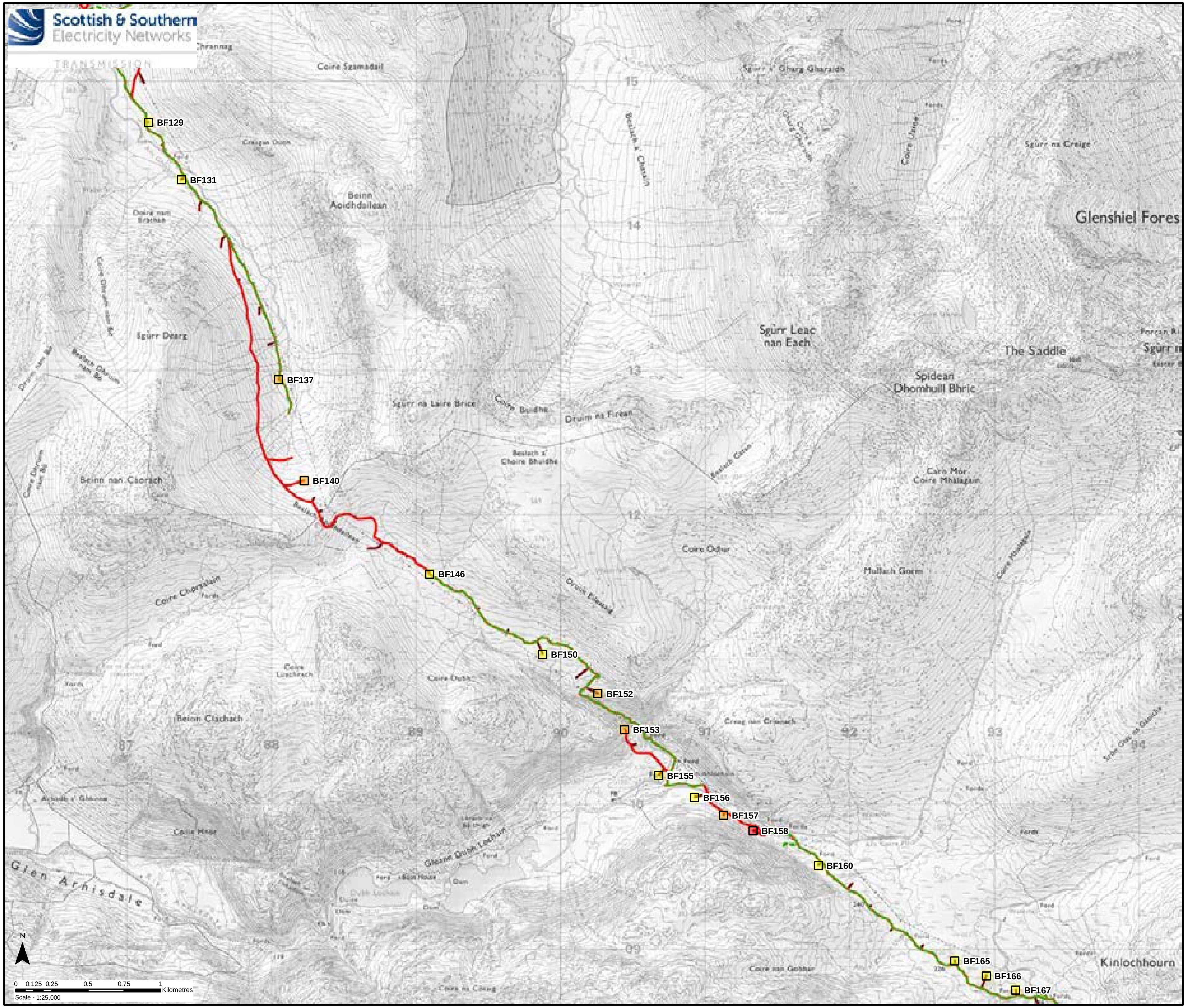
Key

- ☐ Proposed Steel Lattice Tower Section 4 on Peat > 0.5m
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- ▲ New Bellmouth

Peat Slide Risk (At Tower Location)

- Negligible
- Low
- Medium
- High

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 14 - Section 4
Drawn by:	AA Date: 07/09/2022
Drawing:	04707.00020.0113.0



Key

- ☐ Proposed Steel Lattice Tower Section 4 on Peat > 0.5m
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers

Peat Slide Risk (At Tower Location)

- Low
- Medium
- High

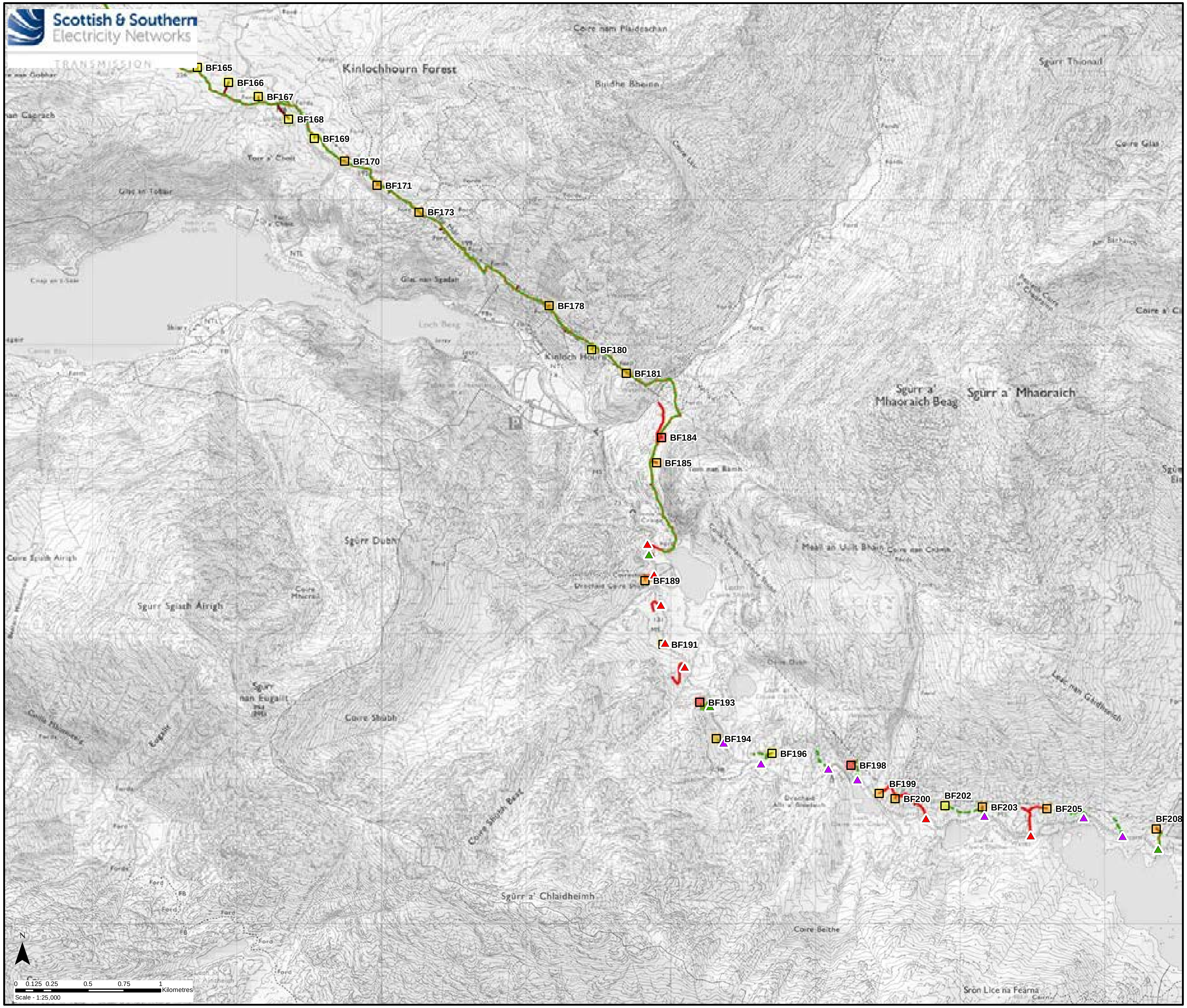
Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Infrastructure with Slide Risk
Map 15 - Section 4

Drawn by: AA Date: 07/09/2022

Drawing: 04707.00020.0113.0



Key

- Proposed Steel Lattice Tower Section 4 on Peat > 0.5m
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth

Peat Slide Risk (At Tower Location)

- Low
- Medium
- High

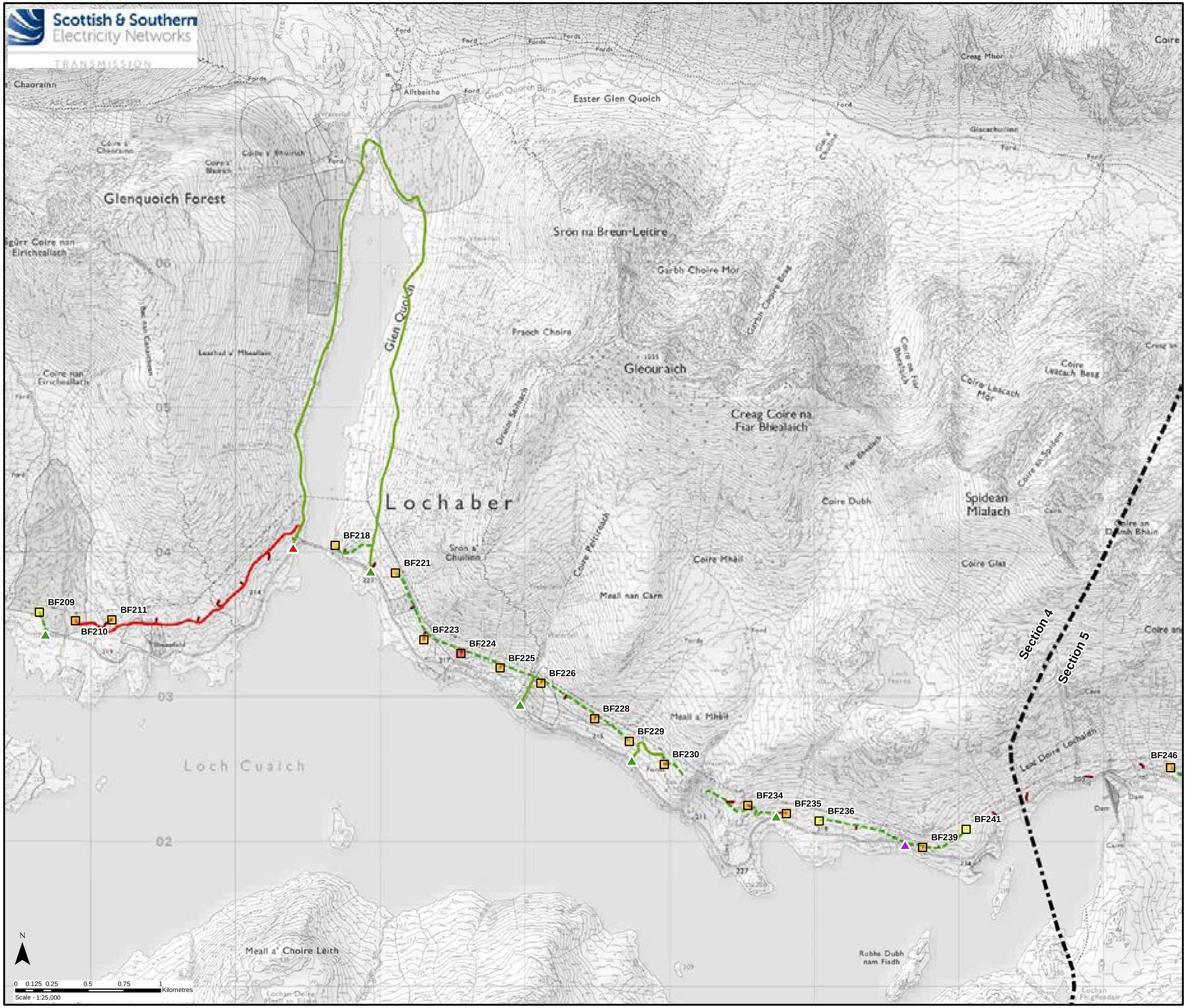
Project No: LT91

Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Infrastructure with Slide Risk
Map 16 - Section 4

Drawn by: AA   Date: 07/09/2022

Drawing: 04707.00020.0113.0



Key

- Proposed Steel Lattice Tower Section 4 on Peat > 0.5m
- Proposed Steel Lattice Tower Section 5 on Peat > 0.5m
- Existing Access Track
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth
- Temporary Bellmouth

Peat Slide Risk (At Tower Location)

- Low
- Medium
- High

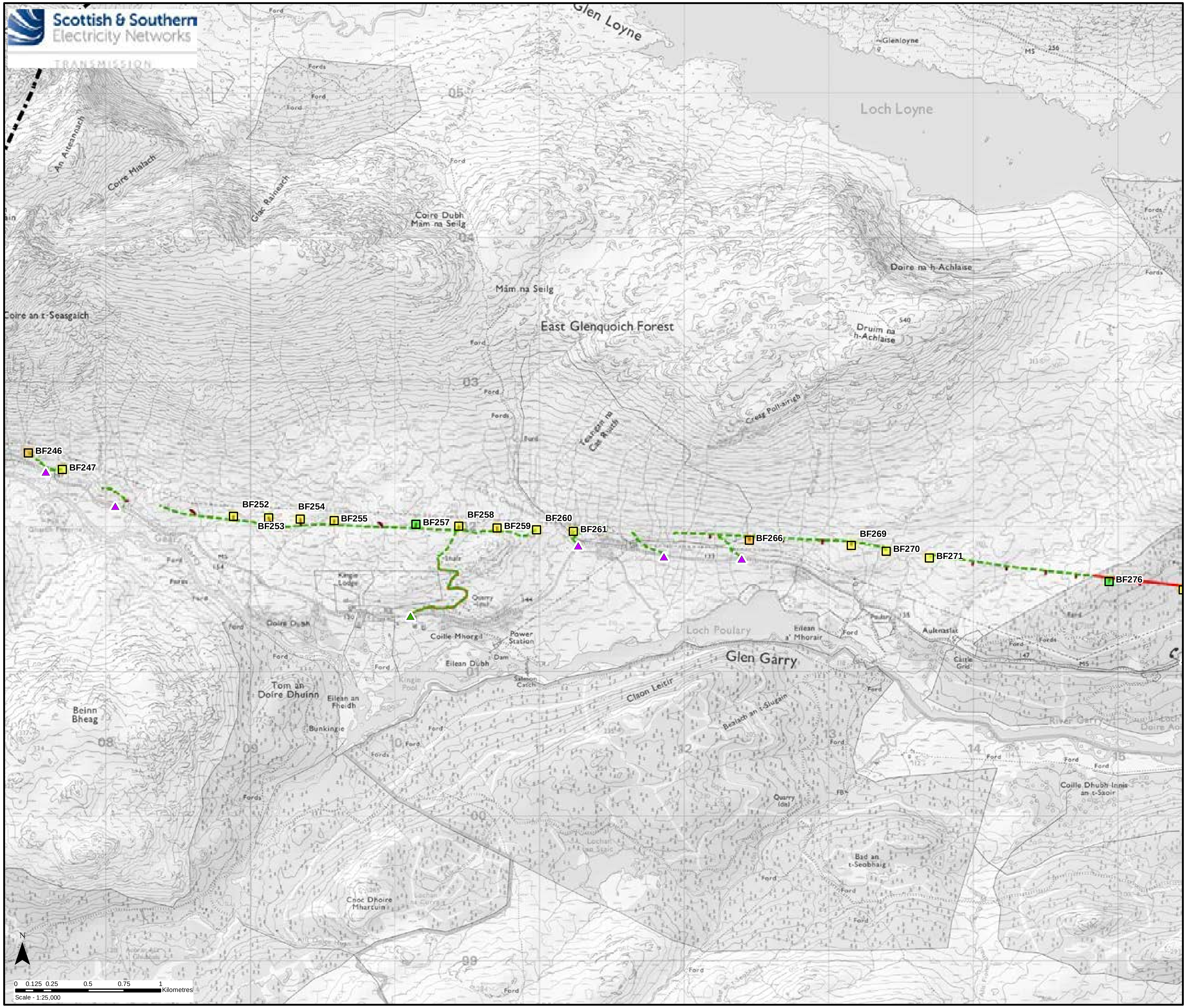
Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Infrastructure with Slide Risk Map 17 - Sections 4 & 5

Drawn by: AA Date: 07/09/2022

Drawing: 04707.00020.0113.0



Key

- Proposed Steel Lattice Tower Section 5 on Peat > 0.5m
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- Temporary Bellmouth

Peat Slide Risk (At Tower Location)

- Negligible
- Low
- Medium

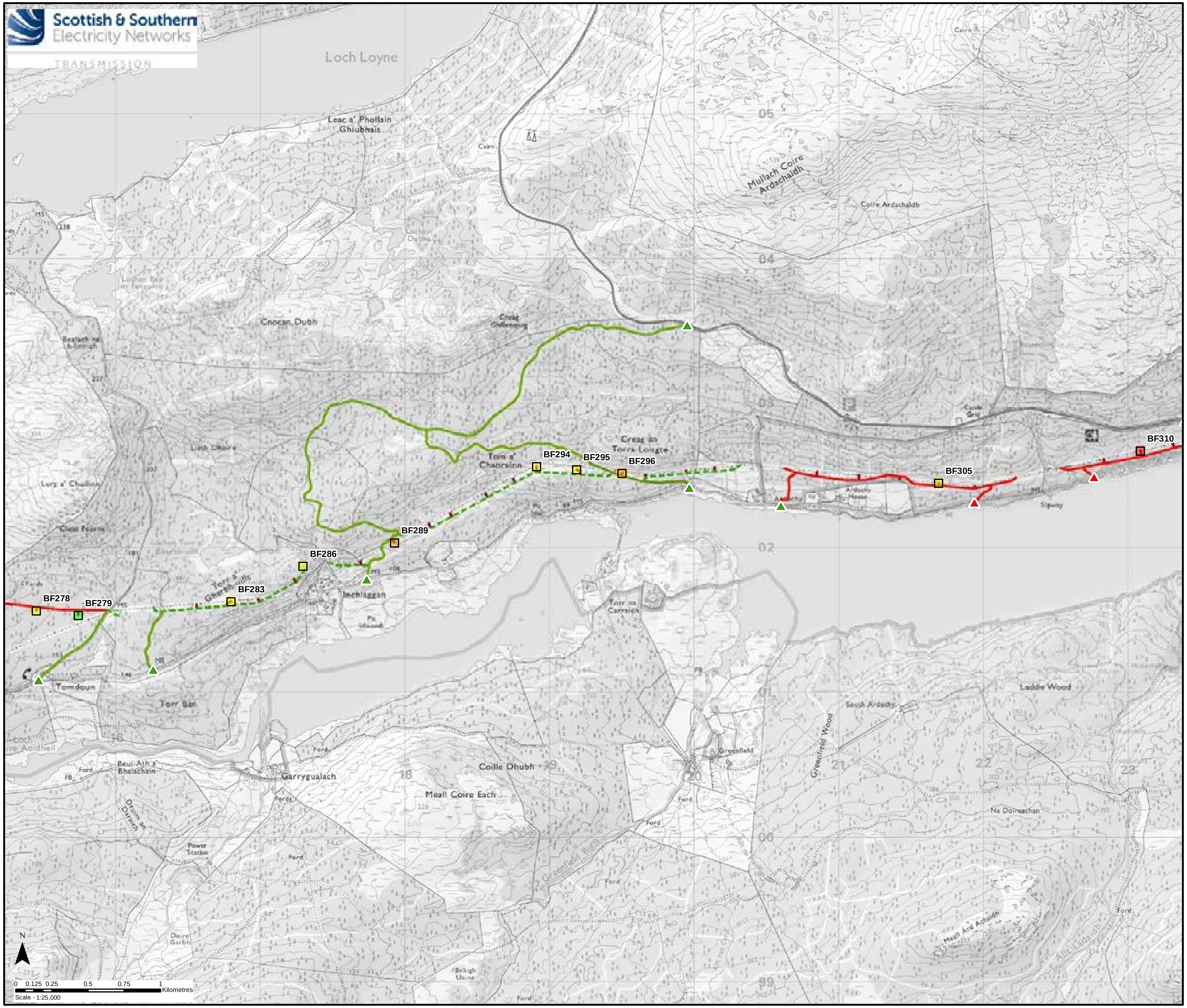
Project No: LT91

Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Infrastructure with Slide Risk Map 18 - Section 5

Drawn by: AA Date: 07/09/2022

Drawing: 04707.00020.0113.0



Key

- Proposed Steel Lattice Tower Section 5 on Peat > 0.5m
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth
- New Bellmouth

Peat Slide Risk (At Tower Location)

- Negligble
- Low
- Medium
- High

Project No: LT91

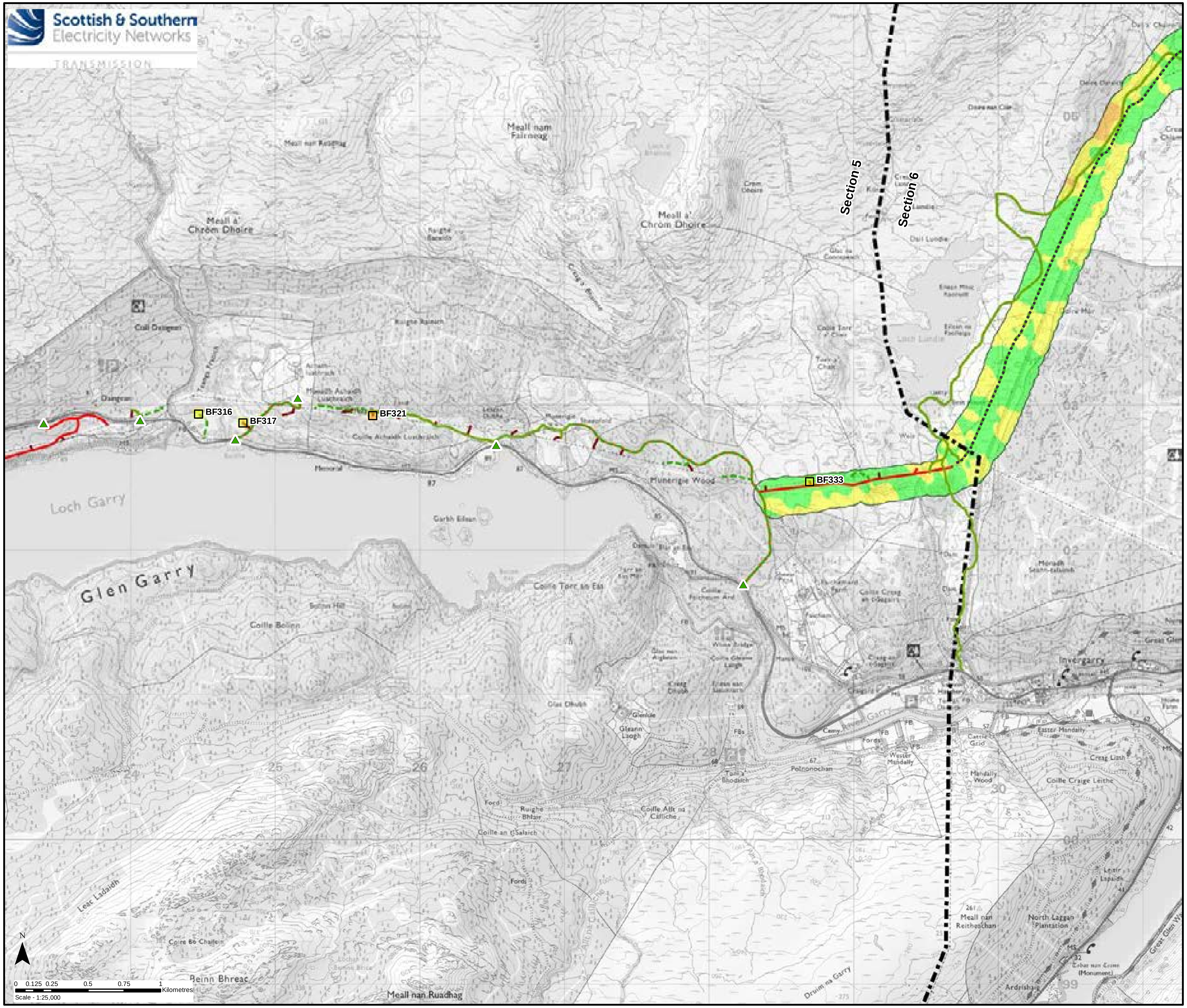
Project: Skye Reinforcement Project EIA Report

Title: Figure V2-7.2.1 Infrastructure with Slide Risk Map 19 - Section 5

Drawn by: AA Date: 07/09/2022

Drawing: 04707.00020.0113.0

Scottish & Southern Electricity Networks
TRANSMISSION



Key

- Proposed Steel Lattice Tower Section 5 on Peat > 0.5m
- Proposed Underground Cable Section 6
- Existing Access Track
- Existing Access Track to be Upgraded
- New Permanent Access Track (construction type to be determined)
- New Temporary Access Track
- New Temporary Spur to Towers
- Existing Bellmouth

Peat Slide Risk

- Negligible
- Low
- Medium

Peat Slide Risk (At Tower Location)

- Low
- Medium

Project No: LT91

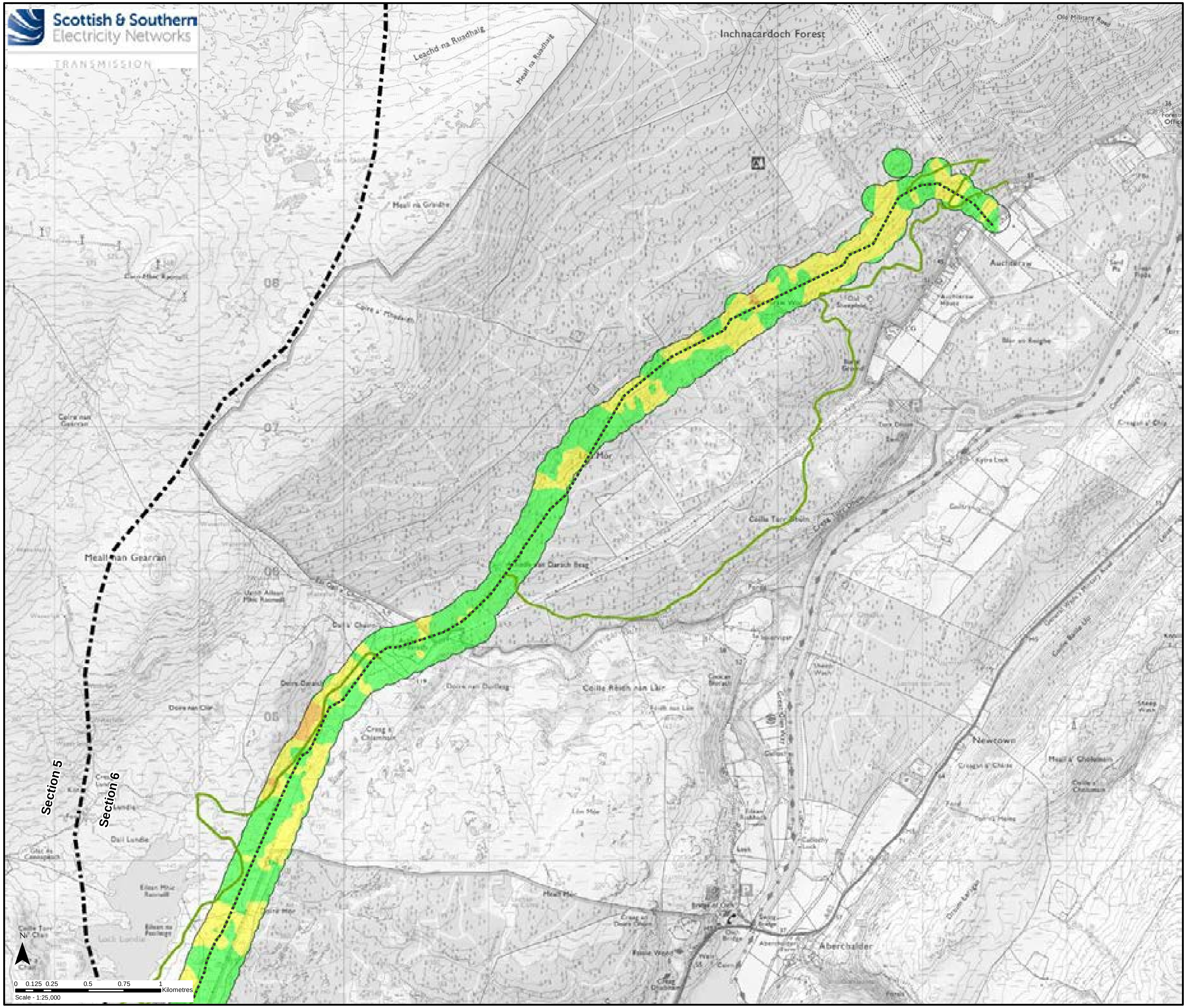
Project: Skye Reinforcement Project
EIA Report

Title: Figure V2-7.2.1
Infrastructure with Slide Risk
Map 20 - Sections 5 & 6

Drawn by: AA   Date: 07/09/2022

Drawing: 04707.00020.0113.0

Scottish & Southern Electricity Networks
TRANSMISSION



Key

Proposed Underground Cable Section 6

Existing Access Track

New Temporary Access Track

Peat Slide Risk

Negligible

Low

Medium

Project No:	LT91
Project:	Skye Reinforcement Project EIA Report
Title:	Figure V2-7.2.1 Infrastructure with Slide Risk Map 21 - Section 6
Drawn by:	AA — Date: 07/09/2022
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