Appendix F. Baseline Bird Surveys

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2016

Kergord Access Track

Appendix F:

Baseline Bird Surveys Technical Report

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Appendix F: Baseline Bird Surveys Technical Report

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Introduction

1. This appendix describes the baseline bird surveys undertaken to inform the assessment of potential effects on bird populations for the proposed Kergord Access Track development.

2. This appendix was produced by Natural Research Projects Ltd (NRP) on behalf of Viking Energy Wind Farm (VEWF).

3. Sensitive information on specially protected species is presented in the Confidential Annex.

Aims of bird surveys

4. The baseline surveys aimed to provide information on which bird species were present in the areas that could plausibly be affected by the proposed development. The baseline surveys undertaken aimed to update the information from previous studies to inform the Viking Wind Farm and that covered a wide area including the proposed development site. From the outset it was recognised that the proposed development could potentially affect several species of high conservation importance including breeding whimbrel, and surveys were designed to be appropriate for these species. Specifically the baseline surveys aimed to:

- Determine the number of pairs of species breeding in a defined survey area;
- Determine the location of the breeding territories;
- Examine the extant of year to year differences in abundance and distribution of breeding birds;
- Determine the use of the development site and its proximity by wintering whooper swans.

Study Area

5. The assessment considers all areas in which birds could plausibly be affected by the proposed development. For all except three bird species known to occur locally it is not considered plausible that effects could extend beyond 500m from the proposed development, therefore a 500m buffer around the proposed development was used to define a generic Bird Survey Area (Figure 1). The baseline moorland birds surveys undertaken in 2015 were undertaken in conjunction with baseline surveys for the adjacent and contiguous B9075 Sandwater Road project (subject of a separate planning application); thus a single survey area was defined (Figure 1) serving both projects. For convenience, the part of the survey area corresponding to the 500m around the development is herein referred to as the 500m development buffer. After the 2015 baseline surveys were completed there were small changes to the proposed alignment of the development and this explains why the western part of survey area does not in parts exactly correspond to a 500m buffer around the final alignment of the proposed track and construction compound (Figure 1).

6. In keeping with best practice (SNH, 2013), it was assumed that effects on three species (red-throated diver, merlin and whooper swan) that breed locally and that have greater spatial sensitivity to disturbance could extend beyond 500m, and therefore for these species baseline surveys extended to at least 2km of the proposed development.

7. At its southern end the route of the proposed development crosses over the Burn of Weisdale and passes through an area of semi-improved pasture (Photo 1) before traversing a large area of open moorland and rough pasture for the remainder of the route to the converter station (Photo 2). From the Upper Kergord Farm buildings and northwards to beyond the proposed location of the converter station the Kergord valley is relatively broad (approx. 500m wide) and flat-bottomed and here the habitats are a mix of damp grassland and blanket bog, habitat that is particularly attractive to several breeding wader species including whimbrel and golden plover.

Photo 1 - View looking south across the southern end of the proposed development. Here the track passes through a mix of unimproved and semi-improved pasture close to Burn of Weisdale.

Photo 2 - View looking south across the middle part of end of the proposed development; the proposed alignment approximately follows the crest of the raised ground in the middle ground on the far right of the photo. Here the proposed development passes through open moorland blanket bog habitats.

Methods

2015 moorland bird surveys

8. Moorland bird surveys (MBS) using the method devised by Brown and Shepherd (1993) were conducted across the Survey Area in 2015. The MBS method is designed to determine the abundance and distribution of birds breeding on extensive open moorland, such as wader, skua, and wildfowl species. (Figure 1). In line with current guidance (SNH, 2013) four visits were made during the breeding season, at approximately four-week intervals between early- May and early-July. All birds seen were marked on 1:15,000 scale field maps (enlarged from OS 1:25,000 base maps) using standard species codes and behaviour notations.

9. The MBS field map registrations of individual birds were interpreted as breeding territories based on the distance separating records of each species within and between survey visits (Brown and Shepherd, 1993). All birds were assumed to be on breeding territories unless they were feeding in unsuitable habitat for breeding (e.g. for most species this would include improved pasture and loch edges) or were part of a flock of apparently non-breeding birds (e.g. post-breeding aggregation of lapwing and greylag geese). In some circumstances additional information such as nest locations and behaviour was also factored in when determining nominal territory centres. For assessment purposes the core areas of moorland bird territories, (i.e. where pairs focus their activity) is assumed to be a 300m diameter circle (in Figure 4 and in Confidential Annex Figures 2 and 3). These circles are only representative of the focal area, the actual area used by some pairs is likely to extend more widely; indeed a few of the records are slightly outside the circles shown on the results maps.

10. The 2015 bird surveys were undertaken by Mark Chapman, a highly experienced local ornithologist who has undertaken a wide range of bird survey work in connection with the Viking Wind Farm and other projects annually since 2005.

11. Outside the breeding season (September to March) the area is known to have very low bird interest, indeed most breeding species are absent through the winter (Viking ES Addendum, 2010). Thus, apart from the surveys for wintering whooper swan, no surveys were undertaken aimed at recording birds outside the breeding season.

Previous moorland bird surveys

12. Historical MBS results for parts of the survey area are also available. These previous surveys were undertaken between 2005 and 2014 by NRP as part of the baseline studies to inform the Viking Wind Farm impact assessment, the development of the Viking Wind Farm Habitat Management Plan and the B9075 Sandwater Road application. Although these historical surveys cover the area of interest, and there is repeated coverage of the parts that are of greatest ornithological value, in none of the previous years was there complete coverage of the 500m development buffer (Table 1).

13. This historical MBS data is of particular value to providing a multi-year overview of the abundance and distribution of breeding whimbrel, and showing that species additional to those detected in 2015 do not regularly use the 500m development buffer.

Surveys of scarce breeding birds

14. Breeding merlin and red-throated diver are two relatively scarce species of high conservation importance that breed widely across Shetland and are particularly sensitive to disturbance. Whooper swan is another scarce species of high conservation importance that has bred locally. The MBS survey method is not well suited to these species, and in any case SNH guidance (SNH, 2013) states that survey work for scarce and sensitive species such as divers and raptors should extend to at least 1km (depending on species) from a proposed development. Annually, since 2005 (with the

exception of 2015 for red-throated diver and whooper swan), these species have been comprehensively monitored by NRP (on behalf of VEWF) throughout Central Mainland Shetland. Results from this wider monitoring are used as the source of information for these species.

15. The monitoring of these three species involves undertaking multiple visits (typically three) to all historical merlin nesting sites and all lochs and lochans potentially suitable for breeding red-throated divers and whooper swan respectively. The aim of this monitoring has been to determine site occupancy and breeding success.

Wintering whooper swan

16. Between mid-October 2013 and February 2014 approximately fortnightly visits were made to check for the presence of wintering whooper swan. Suitable habitat (pasture fields, marsh and lochs) in the Kergord valley and around Sandwater were checked on eight dates between mid-October 2013 and mid-February 2014.

Table 1 - Summary of 2015 and historical bird survey coverage

Species & season	Survey year(s)	Coverage
Moorland birds, breeding (waders, skuas, wildfowl, gulls)	2015	Whole of 500m development buffer
	2014, 2010 to 2012	Vicinity of converter station
	2013	Approx. 75% of 500m development buffer, all except NW quarter
	2008	Approx. southern 35% of 500m development buffer
	2005	Approx. northern 65% of 500m development buffer
Merlin, breeding	All years 2005 to 2015	Central Mainland Shetland
Red-throated diver, breeding	All years 2005 to 2014	Central Mainland Shetland
Whooper swan, breeding	All years 2005 to 2014	Central Mainland Shetland
Whooper swan, wintering	2013/14	Kergord valley and Sandwater

Surveys Result

17. The detailed survey results for species listed on Schedule 1 of Wildlife and Countryside Act and/or Annex 1 of the EU Birds Directive are presented in the Confidential Annex.

18. The survey results available that are relevant to establishing baseline conditions are summarised in Table 2. For species of high or moderate Nature Conservation Importance (NCI, defined in Appendix G), the distribution of breeding territories within the 500m development buffer identified during 2015 is illustrated in Figure 4 and in Confidential Annex Figures 2 and 3. Figure 4 also illustrates the location of the territory of a common sandpiper (moderate NCI) located in survey work in 2013, but not present in 2015.

Red-throated diver

19. The results of the surveys of breeding red-throated diver show that this species does not breed within 2 km of the proposed development. The lack of breeding divers within 2km of the proposed development can be explained by the lack of any lochans within this distance that are suitable for

breeding divers. Furthermore no evidence was obtained during any of the bird survey work of regularly used red-throated diver flight paths over the site.

Whooper swan

20. The results of the baseline surveys of lochs show that this species does not breed within 1km of the proposed development.

21. Wintering whooper swan surveys conducted between October 2013 and February 2014 recorded no whooper swans using the 500m development buffer. The only whooper swans seen were eight birds at the south end of Sand Water Loch in mid-January; these birds were approximately 1.5km from the closest part of the proposed development.

Merlin

22. The results of annual surveys of breeding merlin across Central Mainland Shetland between 2005 and 2015 show that this species did not breed within 1km of the proposed development in this period.

23. Additional information breeding merlin breeding beyond 1 km is presented in the Confidential Appendix.

2015 Moorland Bird Survey

24. Following analysis, the Moorland Bird Survey (MBS) results provide an estimate of the number of breeding territories in the area surveyed for wader, skua, gull, geese and duck species. The estimated number of territories in 2015 of each species in the 500m development buffer is summarised in Table 2. For species of high or moderate Nature Conservation Importance the distribution of breeding territories is illustrated in Figure 4 and in Confidential Annex Figures 2 and 3. In these figures the breeding territories are represented by 300m diameter circle and the locations of records of individual birds seen during surveys by spots (for high NCI species only).

25. The 2015 surveys did not record the presence of several moorland species of high conservation value that breed in reasonable numbers elsewhere in Shetland, namely: dunlin, Arctic skua, great skua, or Arctic tern. Common sandpiper was also not present in 2015.

MBS survey results for other years

26. Estimates of the number of breeding territories derived from MBS results for the 500m development buffer for 2013, 2008 and 2005, when partial surveys were undertaken, are compared against the estimates for 2015 (Table 2). In drawing comparisons with these other years it needs to be recognised that coverage was incomplete in other years. In 2013 approximately 75% of the 500m development buffer was covered. The area that was not covered in 2013 was the north-west quarter, the area which is of least value to breeding birds. The coverage in 2008 and 2005 was complimentary; together the surveys in these two years achieved complete coverage with no overlap. Therefore, a reasonable indication of the total number of territories present in the 500m development buffer in these years can be obtained by addition of the 2008 and 2005 columns.

27. The across-year comparison of the number of territories shows that several moorland species are consistently absent from the 500m development buffer namely; dunlin, Arctic skua, great skua and Arctic tern. It also shows that one species, common sandpiper, which was not recorded in 2015, has been present (maximum of one territory only) in previous years.

28. The comparison with previous surveys also shows that the number of territories of regular breeding species fluctuates year to year. Compared to previous year for which there are estimates, the numbers of territories of lapwing, snipe and redshank present in 2015 were somewhat lower,

whereas the number of whimbrel present was higher. The number of territories of curlew and golden plover identified in 2015 was similar to the numbers in previous years.

29. For all species the total numbers of territories in the 500m development buffer (Table 2) form only a small proportion of the regional (Shetland) population. The number of territories in the 500m development buffer of one species only, common sandpiper, exceed 1% of the assumed regional population breeds in at least some years. The single pair of common sandpiper represents approximately 2% of the assumed, Shetland population of 44 pairs.

30. The single whimbrel territory within the 500m development buffer represent approximately 0.3% of the assumed regional population of approximately 290 pairs (Jackson, 2009). Given the small population size of this species and its unfavourable conservation status, breeding whimbrel is considered to be the bird species of highest importance in relation to the assessment of the proposed development.

31. Table 2: The estimated numbers of breeding territories inside the proposed development 500m buffer in 2015 and in previous years with partial survey coverage.

Species	2015 100% coverage	2013 ca. 75% coverage, all except north-west quarter	2008 ca. 35% coverage, southern third	2005 ca. 65% coverage, middle and north thirds
Oystercatcher	14	19	7	7
Snipe	6	no count	7	7
Redshank	4	4	4	4
Dunlin	0	0	0	0
Lapwing	5	12	8	7
Golden plover	1	1	0	3
Curlew	10	10	9	5
Whimbrel	1	1	1	0
Common sandpiper	0	1	1	0
Arctic skua	0	0	0	0
Great skua	0	0	0	0
Greylag goose	4	2	0	0
Territories with nominal centres outside the 500m buffer around the proposed development are excluded. Coverage in 2008 and 2005 was complimentary so adding the estimates for these two years is likely to give a reasonable indication of the total for the whole area				

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SNH (2013). Recommended bird survey methods to inform impact assessment of onshore wind farms.

Viking Energy (2010). Viking Wind Farm Environmental Statement Addendum.

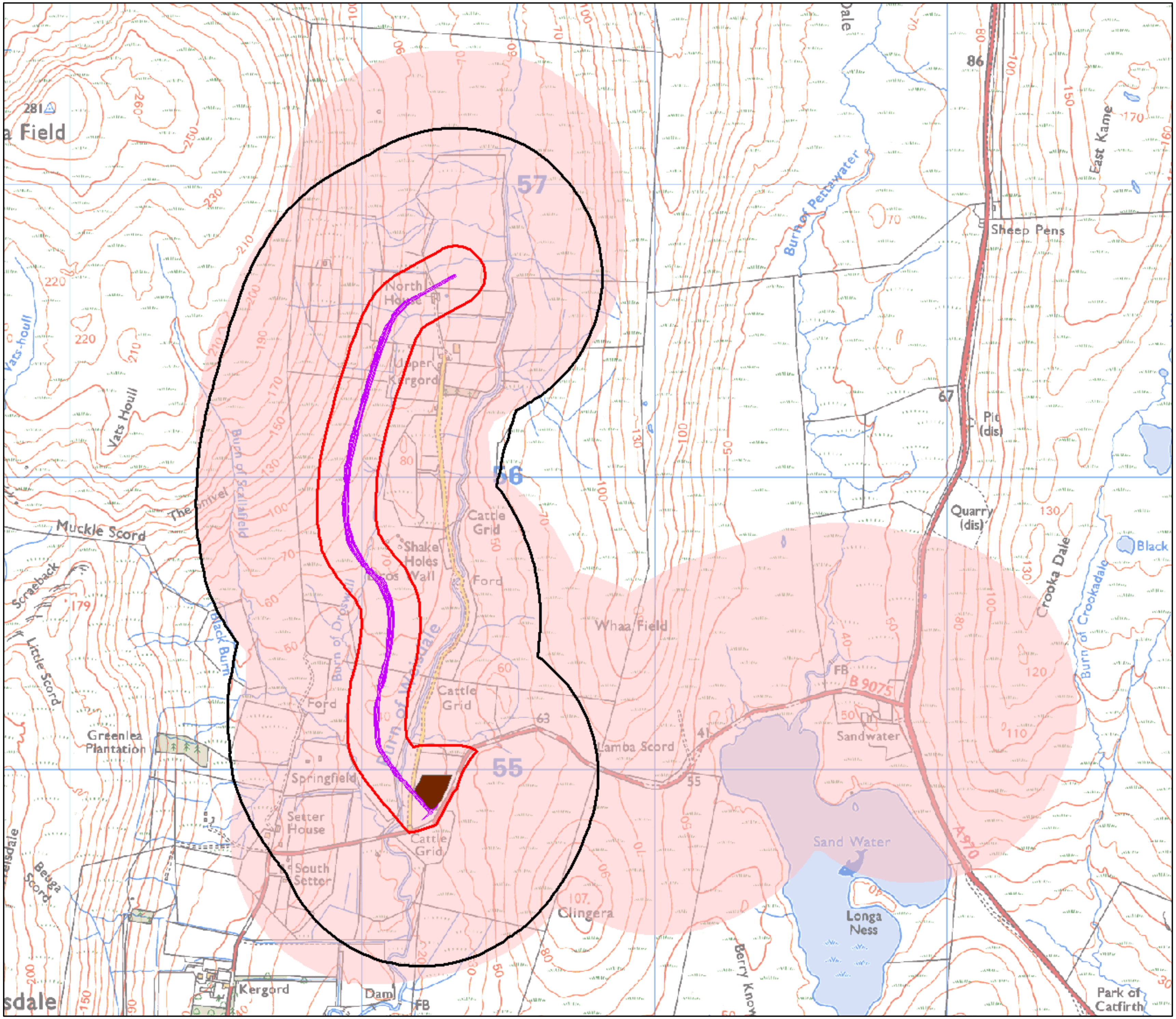

Figure 1
2015 bird survey area

Kergord Access Track
Environmental Appraisal Report

FIGURE 2 OF APPENDIX F (BASELINE BIRD SURVEYS TECHNICAL REPORT) IS PRESENTED IN THE CONFIDENTIAL APPENDIX

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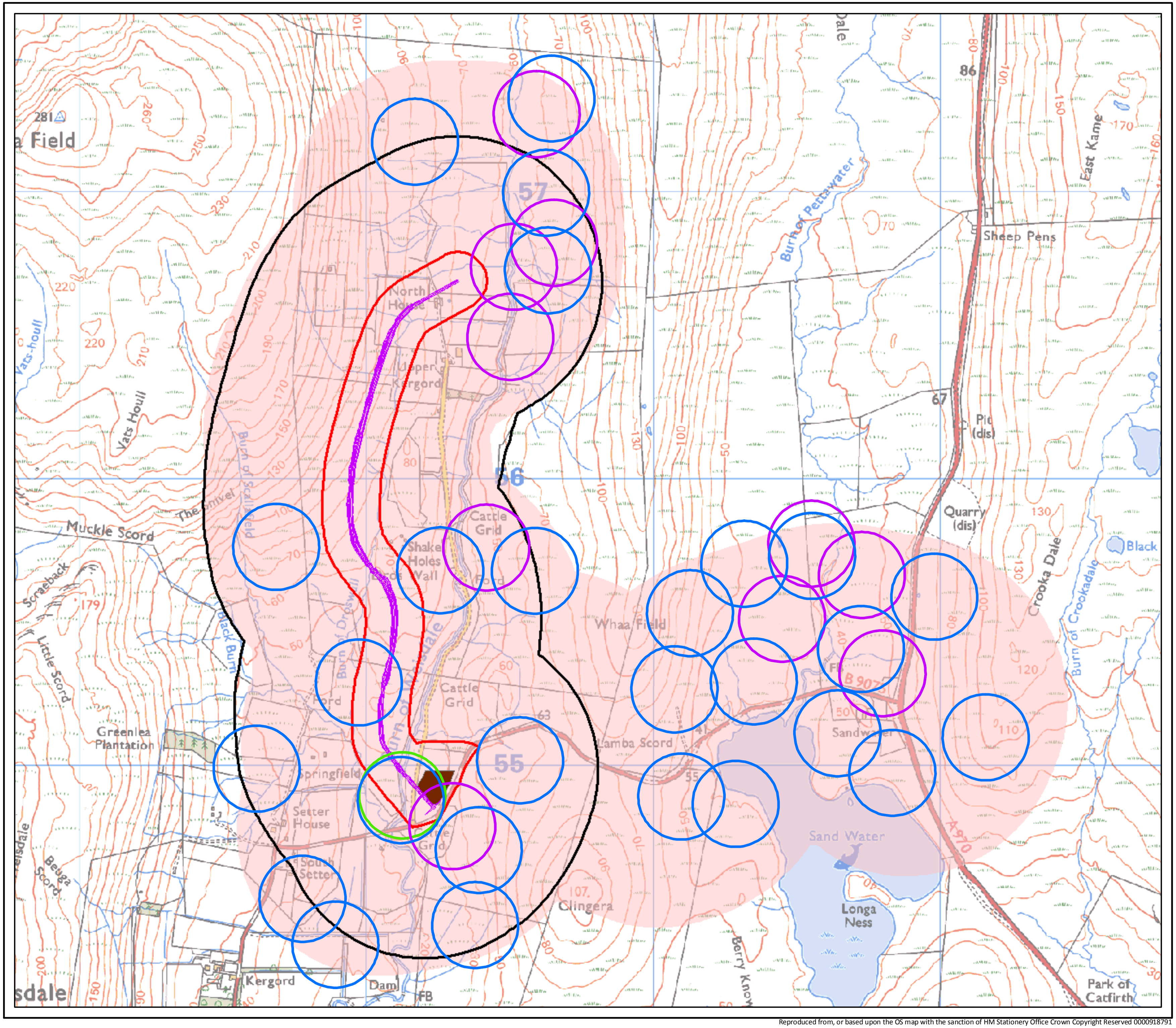

viking energy
Harnessing Shetland's natural resources

nrp NATURAL RESEARCH PROJECTS LIMITED

Key

Proposed development

Site boundary

Construction compound

Proposed development 500m buffer

2015 survey area

Nominal territory centre

Curlew

Lapwing

Common sandpiper

N

Scale 1:12,500 @ A4

0 0.25 0.5 km

Figure 4. Curlew, lapwing and common sandpiper
The results of the 4-visit breeding bird survey undertaken in 2015 and location of common sandpiper territory recorded in 2013

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Appendix G. Ornithology Assessment Methods

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Appendix G: Ornithology Assessment Methods

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Introduction

1. This appendix describes the effects considered for assessment of the Kergord Access Track on ornithological interests, and describes the methods used to characterise effects on bird populations and to assess their significance.

2. This appendix was produced by Natural Research Projects Ltd (NRP) on behalf of Viking Energy Wind Farm (VEWF).

Guidance and legislation

3. The following guidance and information sources have been consulted while undertaking the assessment:

- SNH Guidance: Assessing Significance of Impacts from Onshore Windfarms on Birds outwith Designated Areas (SNH 2006);
- SNH Guidance Recommended Bird Survey Methods to Inform Impact Assessment of Onshore Wind Farms (SNH 2013);
- Scottish Government (SG) Planning Advice Note 1/2013: Environmental Impact Assessment (SG, 2013).
- IEEM (2006). Guidelines for Ecological Impact Assessment in the United Kingdom. Institute of Ecology and Environmental Management.
- the Shetland Islands Council Local Development Plan 2012 Supplementary Guidance on Natural Heritage.

4. The following legislation has been taken into account when undertaking the assessment:

- the Council Directive on the Conservation of Wild Birds 2009/147/EC (the Birds Directive);
- the Wildlife and Countryside Act 1981 (as amended) (WCA);
- the Conservation (Natural Habitats &c) Regulations 1994 (as amended); ('The Habitats Regulations');
- the Town and Country Planning (Environmental Impact Assessment) (Scotland) Regulations 2011 (the EIA Regulations);
- the Nature Conservation (Scotland) Act 2004 (as amended).

Evaluating Effects

5. The assessment determines the potential effects of the proposed development and the likelihood of their occurrence. Effect is defined as change in the assemblage of bird species present as a result of the effects accrued by the proposed development. Change can occur either during or beyond the life of the proposed development. Where the response of a population has varying degrees of likelihood, the probability of these differing outcomes is considered. Note effects can be adverse, neutral or beneficial. In judging whether a potential effect is significant or not, three factors are taken into account:

- the Nature Conservation Importance of the species involved (as defined by criteria in Table 1);
- the magnitude of the likely effect; and
- the conservation status of the species.

6. The significance of potential effects is then determined by integrating the assessments of these factors in a reasoned way. The magnitude of likely effects involves consideration of their spatial and temporal magnitudes. In making judgements on significance by this integration, consideration is given to the

national and regional trends of the potentially affected species, and how the integrated effects may impinge on the conservation status of the species involved at these geographical levels. If a potential effect is determined to be significant, measures to avoid, reduce or remedy the effect are suggested wherever possible. Further details of the process underlying the assessment and the determination of significance follow.

Methods Used to Evaluate Nature Conservation Importance

7. The Nature Conservation Importance of the bird species potentially affected by the proposed development is defined according to Table 1.

8. With one exception the numbers of each species breeding within 500m buffer of the development make up well below 1% of the Shetland population. Only one species, common sandpiper, exceeds 1% of the Shetland population, in some years at least (see Appendix F).

9. Species of low Nature Conservation Importance (Table 2) are not considered further in the assessment. Low Nature Conservation Importance species that breed in the vicinity of the proposed development include snipe, redshank, oystercatcher and greylag goose.

Table 1 - Determining Factors for Nature Conservation Importance

Importance	Definition
High	Species listed in Annex 1 of the EU Birds Directive. Breeding species listed on Schedule 1 of the WCA. Species present in nationally important numbers (>1% national population).
Moderate	Other species listed on the Birds of Conservation Concern (BoCC) 'Red' list (Eaton *et al*., 2015). Regularly occurring migratory species, which are either rare or vulnerable, or warrant special consideration on account of the proximity of migration routes, or breeding, moulting, wintering or staging areas in relation to the proposed development. Species present in regionally important numbers (>1% regional population).
Low	All other species not covered above.

Table 2 - Nature Conservation Importance of bird species and the reason for categorisation

Species (season)	Schedule 1	Annex 1	BOCC Red List	% of Shetland population breeding near development	Nature Conservation Importance
Red-throated diver	Yes	Yes	No	None within 2km	High
Merlin	Yes	Yes	Yes	None within 1km	High
Whooper swan	Yes	Yes	No	None within 1km	High
Dunlin	No	Yes	No	None within 0. km	High
Whimbrel	Yes	No	Yes	<1% within 0.5km	High
Curlew	No	No	Yes	<1% within 0.5km	Moderate
Common sandpiper	No	No	No	*ca*. 2%, up to 1 pair within 0.5km	Moderate
Golden plover	No	Yes	No	<1% within 0.5km	High

Species (season)	Schedule 1	Annex 1	BOCC Red List	% of Shetland population breeding near development	Nature Conservation Importance
Lapwing	No	No	Yes	<1% within 0.5km	Moderate
Ringed plover	No	No	Yes	<1% within 0.5km	Moderate
Arctic skua	No	No	Yes	None within 1km	Moderate
Arctic tern	No	Yes	No	<1% within 0.5km	High
All other species present (including snipe, redshank, oystercatcher, greylag goose)	No	No	No	<1% within 0.5km	Low

Methods Used to Determine Conservation status

10. Where the available data allow, the conservation status of each potentially affected species is evaluated within the Natural Heritage Zone (Shetland). For these purposes conservation status is taken to mean the sum of the influences acting on a population which may affect its long term distribution and abundance. Conservation status is considered to be favourable where:

- a species appears to be maintaining itself on a long term basis as a viable component of its habitats;
- the natural range of the species is not being reduced, nor is likely to be reduced for the foreseeable future; and
- there is (and will probably continue to be) sufficient habitat to maintain the species population on a long term basis.

Methods Used to Evaluate the Magnitude of Effects

11. Effects are judged in terms of magnitude in space and time (Regini, 2000). Magnitude was determined by consideration of the spatial and temporal nature of each effect. There are five levels of spatial magnitude (Table 3) and four levels of temporal magnitude (Table 4). As this is a non-designated site, spatial magnitude was assessed in respect of populations within the appropriate ecological unit.

12. The appropriate geographical unit for all species receptor populations is taken to be the Natural Heritage Zone 1 (NHZ 1), this is defined by SNH as the Shetland Islands including Fair Isle.

Table 3. Scales of Spatial Magnitude

Magnitude category	Description
Very High	Total/near total loss of a bird population due to mortality or displacement. Total/near total loss of productivity in a bird population due to disturbance. Guide: >80% of population affected.
High	Major reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 21-80% of population affected.
Moderate	Partial reduction in the status or productivity of a bird population due to mortality or displacement or disturbance.

Magnitude category	Description
	Guide: 6-20% of population affected.
Low	Small but discernible reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Guide: 1-5% of population affected.
Negligible	Very slight reduction in the status or productivity of a bird population due to mortality or displacement or disturbance. Reduction barely discernible, approximating to the “no change” situation. Guide: < 1% population affected.

Table 4. Scales of Temporal Magnitude

Magnitude category	Description
Permanent	Effects continuing indefinitely beyond the span of one human generation (taken as approximately 25 years).
Long term	Approximately 15 - 25 years or longer (refer to above).
Medium term	Approximately 5 - 15 years.
Short term	Up to approximately 5 years.

13. Sensitivity to a potential effect is considered in assessing its spatial magnitude. Sensitivity to effects can differ between similar species and, for a particular species, some populations and individuals may be more sensitive than others, and sensitivity may change over time, e.g. birds are often more sensitive to disturbance during the breeding season. Sensitivity can also vary according to form of an effect. Displacement, for example, refers directly to behavioural sensitivity to disturbance and the distances of birds to its source.

14. The magnitude of an effect can be influenced by when it occurs. For example, seasonality in a bird population’s occupancy of a site may mean that effects are unlikely during certain periods of the year.

15. Importantly, in determining sensitivity and its contribution to an effect, where such information exists from monitoring sites, data on the responses of individual birds and bird populations to similar developments are taken into account, along with knowledge of how rapidly the population of a species is likely to recover following loss or disturbance (e.g. birds being recruited from other populations elsewhere).

Method used to Categorise Disturbance

16. In categorising the potential for the development to cause disturbance to breeding birds, the existing disturbance environment experienced by birds using the vicinity of the development is taken into consideration. Birds breeding in the vicinity of the existing track to Upper Kergord Road (this lies between 0 and approx. 300 m from the route of the proposed development) currently experience low levels of disturbance from vehicles and pedestrians to which they are likely to be habituated to some extent.

17. To assess the likely effects of disturbance each species is categorised according to its susceptibility to disturbance based on experience of observing these species in Central Mainland Shetland and information in Ruddock and Whitfield (2007). Three disturbance risk categories are defined: low, moderate and high (Table 5). These categories are necessarily an approximation as individuals vary in their response to potential disturbance for the reasons stated earlier. The definitions distinguish between a species’ ‘typical’ response and its ‘maximum’ response. The typical response distance is defined as the approximate threshold distance to which a human or vehicle can normally approach a

breeding bird before it exhibits alarm behaviour or moves away from its nest or chicks. The maximum response distance is defined as the approximate upper distance at which a species is considered to respond to a potential source of disturbance. Individuals are only likely to show a response to a potential disturbance source that is at or approaching this upper distance if it is particularly obvious or aggressive in its approach, or the individual bird is unusually sensitive.

18. For assessment purposes breeding territories were categorised as being at either high, moderate or low/zero risk of being affected by disturbance, based on the closest distance between the proposed development and the nominal territory centre. Territories where this distance is less than the 'typical response distance' are categorised as being at high risk of being affected by disturbance. Territories where this distance is greater than the typical but below the maximum response distance are categorised as being at medium risk of being affected by disturbance. For assessment purposes it is judged that, due to their close proximity, construction activities could cause adverse disturbance for a single breeding season to all 'high risk' territories either preventing birds settling to breed, causing them to move elsewhere or causing breeding failure. Taking into consideration the greater distance from the potential source of disturbance, it is also judged that on average half of the 'moderate risk' territories would be adversely affected in the same way.

19. Merlin, red-throated diver and whooper swan are judged to have a relatively low tolerance to disturbance (Table 5). However, baseline surveys show that these species do not breed within 1km of the proposed development, and so it is not plausible that they would be affected.

Table 5: Distance thresholds for each Disturbance Risk Category

Disturbance risk category	High risk 'typical' safe distance threshold	Moderate risk 'maximum' safe distance threshold	Species
High	300m	500m	Merlin, red-throated diver (at breeding lochans), whooper swan
Moderate	200m	300m	Arctic skua, great skua, golden plover, lapwing, redshank, whimbrel, curlew, greylag goose
Low	100m	200m	Oystercatcher, snipe, common sandpiper, dunlin

Method Used to Categorise Habitat Change

20. In a worst case scenario habitat changes could lead to the abandonment of some territories or lower their quality such that they can no longer support successful breeding. Nevertheless both of these outcomes are considered to be relatively unlikely as on average the proportion of a territory affected is likely to be small and the changed habitat will not necessarily be unsuitable for a species. Indeed some changes may be beneficial for some species, for example species than feed on bare or sparsely vegetated ground. The effects of habitat change on birds will also depend on how quickly disturbed ground recovers and the nature of the vegetation that establishes.

21. For assessment purposes, habitat loss and change is assumed to affect territories where the footprint of the road, earthworks or construction compound overlaps the core area of a breeding territory area. This is defined as a circle of 300m diameter centred on the 2015 nominal territory centres (2013 territory centre in the case of common sandpiper).

Determining Significance of Potential Effects

22. SNH guidance for assessing the significance of effects on birds outside designated areas (SNH 2006) states that "An impact should be judged as of concern where it would adversely affect the favourable

conservation status of a species, or stop a recovering species from reaching favourable conservation status, at international or national level or regionally".

23. Following the classification of each species' Nature Conservation Importance (Tables 1 and 2), for each species to be assessed the temporal and spatial magnitudes of each potential effect is considered. The temporal magnitude is typically largely dependent on the duration of the phase of the development (Table 4). The spatial magnitude of likely effects involves consideration of the number of birds or breeding attempts that may be affected, which is derived from the results of baseline surveys after application of knowledge on sensitivity to the particular effect. This is then translated to a classification of spatial magnitude (Table 3) by reference to available information on the abundance of the regional population. A species' Nature Conservation Importance, the duration of the effect (temporal magnitude) and the effect's level of spatial magnitude are integrated to reach a judgement on effect significance. In this integration the form of the effect's spatial magnitude is considered (e.g. mortality, displacement or failed breeding) as regards its influence on the population's demography. Hence the integration results from the species' Nature Conservation Importance (high or moderate), and the demographic sensitivity of its population to the form, scale and duration of the effect. In making judgements on significance by this integration, consideration is given to the national and regional trends of the potentially affected species, and how the integrated effects may impinge on the conservation status of the species involved at these geographical levels.

24. In accordance with the EIA Regulations, each likely effect is evaluated and classified as either significant or not significant. The significance levels of effect on bird populations are described in Table 6. Effects resulting in detectable changes in the conservation status of regional populations of Nature Conservation Importance are automatically considered to be significant effects for the purposes of the EIA Regulations (i.e. no distinction is made between effects of "major" or "moderate" significance). Non-significant effects include all those which are likely to result in barely detectable (minor) or non-detectable (negligible) changes in conservation status of regional (and therefore national) populations.

Table 6. Significance criteria

Significance of Effect	Description
Major	Detectable changes that will likely have a severe effect on the conservation status of a regional population of Nature Conservation Importance or a population recognised for its conservation importance.
Moderate	Detectable changes that will likely have an effect on the conservation status of a regional population of Nature Conservation Importance or a population recognised for its conservation importance.
Minor	Small or barely detectable changes that will be unlikely to have an effect on the conservation status of a regional population of Nature Conservation Importance or a population recognised for its conservation importance.
Negligible	No or non-detectable changes in the conservation status of regional populations of Nature Conservation Importance or a population recognised for its conservation importance.

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Appendix H. Catchment Descriptors

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Appendix H - Catchment Descriptors

Table 1: Watercourse Catchment Descriptors

Watercourse	Burn of Weisdale	Burn of Droswall	Sandwater Burn
Grid Reference	HU 40350 55450	HU 40050 54850	HU 41500 55150
Catchment Area (km^2)	7.14	2.17	6.73
ALTBAR	123	127	99
BFIHOST	0.486	0.589	0.363
DPSBAR	163.2	149.4	144.6
FARL	0.997	1.000	0.927
PROPWET	0.52	0.52	0.52
SAAR	1347	1322	1276
SPRHOST	58.13	45.1	58.47
URBEXT1990	0	0.0006	0

1. ALTBAR represents the mean catchment altitude (m above sea level). These values are generally consistent with topographic levels discussed previously.

2. BFIHOST is a measure of catchment responsiveness to rainfall. Each of the soil types in the UK have been delineated into 29 specific HOST (Hydrology of Soil Types) classification. A Baseflow Index (BFI) value is determined from the designated HOST value for the catchment. BFI values range between 0.170 and 1.0 in the UK. The BFI may be thought of as a measure of the proportion of the river runoff that derives from stored sources; the more permeable the rock, superficial deposits and soils in a catchment, the higher the BFI and the more sustained the river's flow during periods of dry weather. Thus the BFI is an effective means of indexing catchment geology. The BFIHOST values for the catchments in Table 1 are in the mid-low range of values, suggesting relatively impermeable geology with watercourses dominated by surface water inputs rather than a significant baseflow component.

3. SPRHOST is also a measure of catchment responsiveness to rainfall in terms of the Standard Percentage of Runoff (SPR). This represents an average value for the percentage of rainfall which would be expected to exceed the infiltration capacity of underlying soils and geology, leading to runoff. An SPR value is determined from the designated HOST value for the catchment. SPR values range between 2% and 60%. The SPRHOST values for the catchments in Table 1 are therefore in the high range of values, confirming that the watercourses are dominated by surface water inputs rather than a significant baseflow component.

4. However, the assessment of the permeability of underlying geology based on BFIHOST and SPRHOST values is less accurate than more site-specific investigations .

5. The mean slope of the drainage path (m/km) within the catchment is represented by the DPSBAR value. Approximately 80% of catchments within the FEH have a DPSBAR value lower than 150. The values for DPSBAR in Table 1 are relatively high suggesting that here are steep aspects to the catchments. In particular, the Burn of Weisdale, is shown to have a mean drainage path slope in the top 20% of UK catchments.

6. A FARL value close to 1 indicates that there is little attenuation of flood waters in reservoirs or lakes within the catchment. A FARL value lower than 0.9 suggests that there is significant attenuation offered by lakes or reservoirs within the catchment.

7. PROPWET represents a measure of the proportion of time that catchment soils are defined as wet (the FEH defines 'wet' as being when soil moisture deficits are less than 6 mm). PROPWET values range from over 80% in the wettest catchments to less than 20% in the driest parts of the country. Values of 58% for the catchments in Table 1 are therefore mid-range.

8. Each of the catchments has an URBEXT (Urban Extent) value close to or zero due to the lack of any urban surfaces within the catchment.

Appendix I. Cultural Heritage Gazetteer

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Appendix I – Cultural heritage Gazetteer

1. **Crofting Township**
   A crofting township comprising twelve unroofed buildings, one partially roofed building, two roofed buildings, nine enclosures, three sheepfolds and two lime kilns is depicted on the 1st edition of the OS 6-inch map (Orkney & Shetland (Shetland) 1880, sheet xliii). Two partially roofed buildings, four roofed buildings, three enclosures and Sheep Pens are shown on the current edition of the OS 1:10000 map (1973).

2. **Possible Mill, Burn of Swirtars**
   One unroofed building lying adjacent to Burn of Swirtars which may be a mill is depicted on the 1st edition of the OS 6-inch map (Orkney & Shetland (Shetland) 1880, sheet xliii), but it is not shown on the current edition of the OS 1:10000 map (1973). A walkover survey in July 2013 identified the roughly rectangular structure of the possible mill on the north bank of the Burn of Swirtars.

3. **Building, Burn of Weisdale**
   Two unroofed buildings depicted on the 1st edition of the OS 6-inch map (Orkney & Shetland (Shetland) 1880 sheet xliii), but it is not shown on the current edition of the OS 1:10000 map (1973). A two chambered unroofed drystone structure was seen during a survey in July 2013.

4. **Weisdale, Croft**
   A field survey by GUARD located a demolished croft, 20m N of North House beside a track. The main structure appears to be rectangular and North-South aligned, and built of drystone masonry. There are outbuildings on the hill to the West of the structure.

5. **Kergord, Clearance Cairn (prehistoric)(possible), Ditch (prehistoric)(possible), Structure (post medieval)**
   A watching brief was undertaken, February 2013, during the excavation of 57 test pits prior to the construction of an electricity convertor station. A number of topographic features and geophysical anomalies of potential archaeological interest were targeted. It was found that across the majority of the site shallow topsoil overlay the natural glacial till deposits. An area of unimproved land in the North part of the site contained peat deposits of between 0.5 and 0.7m deep. A number of features of archaeological interest were identified, including a post-medieval sub-circular structure, a possible prehistoric ditch or pit and a potentially prehistoric clearance cairn within the peat deposits. Some of the topographic features appear to be associated with crafting period management of the water course that runs East–West through the area.

6. **Old Sheepfold**
   An 'Old Sheepfold' is marked on the Ordnance Survey First Edition map of 1880 (Shetland Sheet XLIII); the structure is also on the Second Edition map of 1902 (Zetland Sheet XLIII). No structure was visible during a walkover survey in July 2013; the locality of the sheepfold is an open area near the Burn of Weisdale.

7. **Ford, Burn of Weisdale**
   A 'Ford' is marked on the Ordnance Survey First Edition map of 1880 (Shetland Sheet XLIII). A ford was visible at this location on the Burn of Weisdale during a walkover survey in July 2013.

8. **Ford, Burn of Weisdale**
   A 'Ford' is marked on the Ordnance Survey First Edition map of 1880 (Shetland Sheet XLIII). A ford was visible at this location on the Burn of Weisdale during a walkover survey in July 2013.

9. **Ford, Burn of Weisdale**
   A 'Ford' is marked on the Ordnance Survey First Edition map of 1880 (Shetland Sheet XLIII).

10. **Ford, Burn of Weisdale**
    A 'Ford' is marked on the Ordnance Survey First Edition map of 1880 (Shetland Sheet XLIII).

11. **Ford, Burn of Weisdale**

A ‘Ford’ is marked on the Ordnance Survey First Edition map of 1880 (Shetland Sheet XLIII). A ford was visible at this location on the Burn of Weisdale during a walkover survey in July 2013.

12. **Ford, Burn of Weisdale**
A ‘Ford’ is marked on the Ordnance Survey First Edition map of 1880 (Shetland Sheet XLIII).

13. **Enclosure (or unroofed structure)**
A small rectilinear enclosure is marked on the Ordnance Survey Second Edition map of 1902 (Zetland Sheet XLIII). While no building was visible, a small (5m by 5m) enclosure defined by wooden posts and slats was visible during walkover survey on the east side of a road at 440168 1154800.

14. **Buildings, Burn of Weisdale**
The survey of the Scattald or Commonty of Weisdale, Zetland of c.1856, depicts a group of three buildings to the west of the Burn of Weisdale and east of Setter. No building remains were encountered in this area during a walkover survey in July 2013, though this area is an area of dry ground above the burn. It is possible this may be the same as Site 3 (Burn of Weisdale).

15. **Bank (earthwork), Burn of Weisdale**
Remains of a curved earthen bank, 1m wide at its base and 0.3m high, truncated by drains at various sections (White 1998). During a walkover survey in July 2013 the above site was visible as an east/west linear feature commencing at 440348 1155032, that turned southwards as its west end at 40286 55037 after 60m before running south for c.160m to 440263 1154874.

16. **Bank (earthwork), Burn of Weisdale**
Substantial turf bank with steep sides, 2m wide and 1m high, running West-East. Possible continuation of Shetland’s Sites and Monuments Record (SMR) 5494. Turf bank running West-East. Quite substantial with steep sides and measures up to 1m high and 2m wide at the base. Possibly a continuation of bank SMR 5494 (White 1998). This is likely Site 21, an area of the west/east and south/north turf bank identified during walkover survey in July 2013.

17. **Building, Burn of Weisdale**
A small circular structure, 4m in diameter, defined by a bank 1m high with an entrance on the burn side. Some stone visible on the inside of the bank (Shetland SMR). A small circular structure consisting of a circular bank which measures 1m high and has an external diameter of 4m. An entrance was noted on the burn side. Some stones were noted on the inside of the bank (White 1998). During a site walkover survey in July 2013, a roughly circular area marked by peat erosion adjacent to the burn was seen at the location provided by the SMR.

18. **Structure, Burn of Weisdale**
During a walkover survey in July 2013, an area of peat erosion adjacent the burn was seen at the location provided by the SMR.

19. **Ford, Burn of Weisdale**
A ford was visible at this location on the Burn of Weisdale during a walkover survey in July 2013.

20. **Bank (earthwork), Burn of Weisdale**
During a walkover survey in July 2013 a system of earth boundary banks, roughly 1m wide and 1m high, was seen to form the east, south-east and south-west sides of a field.

21. **Bank (earthwork), Burn of Weisdale**
During a walkover survey in July 2013 a roughly inverted-T-shaped area of earth banks, roughly 1-2m wide and 0.5-1m high. The base of the 'T' (i.e. the southern bank) ran from 4440167 1155075 to 440199 1155075, while the north/south running bank to the north ran from 440184 1155075 to 440188 1155094. This is likely the same as Site 16, identified by White in 1998.

22. **Bank; Ditch; Boundary, Burn of Weisdale**
During a walkover survey in July 2013 a 2 to 3m wide former drain, now largely infilled, and visible as a linear depression covered with water-loving vegetation was seen to run east-west from 440240 1154851 to 440188 1154856.

23. **Bank (earthwork), Burn of Weisdale**
An 8m long, 2m wide and 0.5m high earth mound running west/east from 440286 1155059 to 440279 1155057 was visible during a walkover survey in July 2013. The bank showed evidence for peat erosion or cutting and to the south and west in the close vicinity there were further amorphous mounds that likely represented spoil from the cutting of modern drains by machine.

24. **Bank (earthwork), Burn of Weisdale**
A roughly 1m wide and up to 1m high turf bank was seen to run south-north between 440147, 1154985 and 440150, 1155042 during a walkover survey in July 2013.

25. **Bank (earthwork), Burn of Weisdale**
A turf bank line was visible running from 440052 1154831 to 440056 1154819 during a walkover survey in July 2013.

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Appendix J. Peat Slide Hazard Risk Assessment

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Kergord Access Track

Viking Energy Wind Farm

Peat Landslide Hazard and Risk Assessment

B1486007/KAT/PLHRA | 2

21st June 2016

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Kergord Access Track

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Document title:	Peat Landslide Hazard and Risk Assessment
Document No.:	B1486007/KAT/PLHRA
Revision:	2
Date:	21 June 2016
Client name:	Viking Energy Wind Farm
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Contents

Executive Summary

In April 2012, Viking Energy Wind Farm (VEWF) was granted outline planning consent to build the 'Viking Wind Farm', comprising 103 wind turbines located across mainland Shetland, Scotland. The Viking Wind Farm includes a number of access points from the local road network, with one of these being Kergord Access Track, which will provide access from the B9075 to the north-west section of the wind farm and new sub-station.

The proposed track is aligned roughly north-south, and rises through the Valley of Kergord, crossing the Burn of Weisdale and its tributaries, including the Burn of Droswall. The development corridor is covered by extensive and highly variable peat deposits.

The proposed development will entail construction of 2090m of new track, including a new bridge over the Burn of Weisdale. Earthwork embankment side slopes are anticipated to be formed to finished gradients of 1V:2H, while permanent cutting slope gradients are likely to be trimmed to gradients of circa 1V:4H. The provisional track alignment shows the route to predominantly run in shallow cutting, and will entail the excavation and removal of peat to full thickness throughout the route in order to support heavy axle loads.

The superficial deposits at the site mainly comprise blanket peat deposits, with a small deposit of Glacial Till recorded towards the north of the route corridor. Areas of Made Ground and hardstanding, associated with road pavement construction and minor earthworks, are anticipated locally along the existing Upper Kergord Track. The solid geology along the track generally comprises the Scatsta Quartzitic Group to the north and the Weisdale Limestone to the south. There is a vertical 'strike-slip' fault (dextral movement) located approximately 300m at its nearest point to the south-west of the site, orientated north-west – south-east.

Four phases of ground investigation have been carried out to inform development of the proposed route alignment. An initial investigation, undertaken in 2009, served to characterise the general distribution of peat deposits within the development area, and established that the greatest peat thicknesses are typically encountered in the southern half of the development area. Further peat probing, undertaken in September 2013, November 2015 and March 2016, proved peat thicknesses of up to 3.9m and further confirmed that peat coverage was thinner on the steeper northern slopes and alongside watercourses.

A peat landslide and hazard risk assessment has been conducted to help identify areas where peat deposits may be at higher risk of instability, so such areas may be avoided where possible. For the purposes of assessment, the risk of peat instability has been considered for a series of 100m long sections along the proposed route corridor. Each section has been assigned a susceptibility score based on the a number of factors that are known to contribute to peat instability, namely surface slope angle and peat thickness, sub-stratum and peat interface, peat strength, hydrology, evidence of peat instability and rainfall. In addition, each 100m interval was also given an exposure score based on the proposed development's proximity to receptors within the surrounding area. These scores are combined together to give the overall Peat Slide Score and Risk Assessment Rank. This ranking provides a means of comparing the 100m sections across the site and to assist in the design and planning of risk mitigation measures in construction.

Between proposed route chainages 0m and 2000m, the peat landslide hazard and risk assessment indicates that peat deposits present a medium to high risk of peat slide. Peat deposits between chainage 900m and 1000m are considered to present a very high risk of instability. Peat deposits present between chainage 2000m and 2090m have been assessed to present a low risk of instability. The areas assessed as high risk typically exhibit peat deposits in excess of 3.9m thick, with slope angles steeper than 10 degrees. Failure in such areas has a high potential for adverse impact on water quality within the principal water courses that drain the development area. The risk assessment will be reviewed continually, as further ground investigation findings become available, and construction methodologies and mitigation methods outlined in this report are evaluated and incorporated in design, as appropriate to each section of the route.

1. Introduction

1.1 Background

In April 2012, Viking Energy Wind Farm (VEWF) gained consent to build the 'Viking Wind Farm', which comprises 103 wind turbine generators, located across mainland Shetland, Scotland. The Viking Wind Farm will require a number of access points from the local road network. One of these is the Kergord Access Track, off the B9075. The intention is to progress construction of this track separately from the remainder of the wind farm development. A planning application will therefore be submitted to Shetland Islands Council for the Kergord Access Track.

Kergord Access Track will provide access from the B9075 to the north-west section of the wind farm, where a new sub-station is to be located in Upper Kergord. The proposed track will pass through an area of extensive and highly variable peat cover. Enabling works for the track construction will impact on these peat deposits and hence a Peat Landslide Hazard and Risk Assessment (PLHRA) is required to be provided in support of the planning application.

Jacobs has been commissioned to prepare the PLHRA for the 'Kergord Access Track'. The PLHRA shall be undertaken in accordance with the Scottish Executive guidance note, December 2006[04], and the Scottish Environment Protection Agency (SEPA) guidance, January 2012[05]. In addition to this report, a separate summary statement on the peat assessment will be prepared for inclusion within the Environmental Appraisal Report (EAR). The objectives of the EAR are to:

- set out the description of and justification for the access track;
- present baseline environmental information on the location of the proposed development;
- provide an assessment of potential effects; and
- set out any recommended mitigation

1.2 Scope and Structure of the Report

The PLHRA includes a summary of desk study information and fieldwork records. These records were reviewed to model ground conditions and assess the risk of peat instability, through a pseudo-quantitative hazard/susceptibility scoring system. The assessment was used to classify the risks associated with construction of the proposed development and identify mitigation measures to be adopted during construction. This report is structured to reflect the stages of data gathering, site reconnaissance and investigation, risk assessment and risk management, in accordance with the SEPA guidance. The main body of the report is structured as follows:

- Section 2- *Desk Study* - a summary of the geology, hydrology, hydrogeology, aerial photography, geomorphology, topography, site history and potential environmental receptors.

- Section 3- *Site Reconnaissance and Fieldwork* - a review of the findings of site reconnaissance and peat probing/coring surveys.

- Section 4- *PLHRA* - a hazard and risk peat slide assessment, based on available factual information, such as peat thickness, local site conditions, hydrology and slope gradient.

- Section 5- *Construction Methodologies and Control Measures* – a summary of mitigation and construction considerations for the proposed development, based on the findings of the PLHRA analysis.

1.3 Limitations

The findings and opinions contained within this report are based on information obtained from a variety of sources, as detailed in the report, which are assumed to be reliable. Nevertheless, the authenticity or reliability of the information cannot be guaranteed.

This initial PLHRA assessment is based on an agreed scope of works with VEWF to support a planning application for the ‘Kergord Access Track’. It is not intended to describe the full extent of conditions across the site. Appropriate ecological and hydrological constraints will be considered separately outside this report. It is anticipated that further investigation and site reconnaissance will be required in order to further develop the PLHRA prior to construction. Discussions relating to the sub-station to the north of the proposed development, and compound area to the south, are beyond the scope of this report.

This report is provided to identify the potential for peat slides at various points along the proposed route and so enable VEWF to manage the risk of peat slides along the ~2km section of the proposed development. These risks can be reduced through the implementation of mitigation measures, which may be further refined following additional research and investigation works. Recommendations for mitigation measures, recommended additional research and investigation works are identified, along with their anticipated impact on risk.

1.4 Site Description

The Viking Wind Farm development is located in the central mainland, Shetland Islands. The proposed development covers the provision of an alternative access track through the Valley of Kergord to serve the proposed converter station within Upper Kergord. The proposed development provides access from the B9075, running northwards from a junction immediately east of the existing crossing over the Burn of Weisdale. Construction will entail 2090m of new 6m wide track, plus two 1m wide verges, with cuttings and embankments along the scheme[18]. The southernmost section of the route runs along the eastern side of the valley, prior to crossing the Burn of Weisdale and existing Upper Kergord track. The route then continues northwards along the western flank of the valley. Extensive and highly variable deposits of peat cover the proposed development corridor. Figure 1-1 shows the general site location in the central mainland, Shetland.

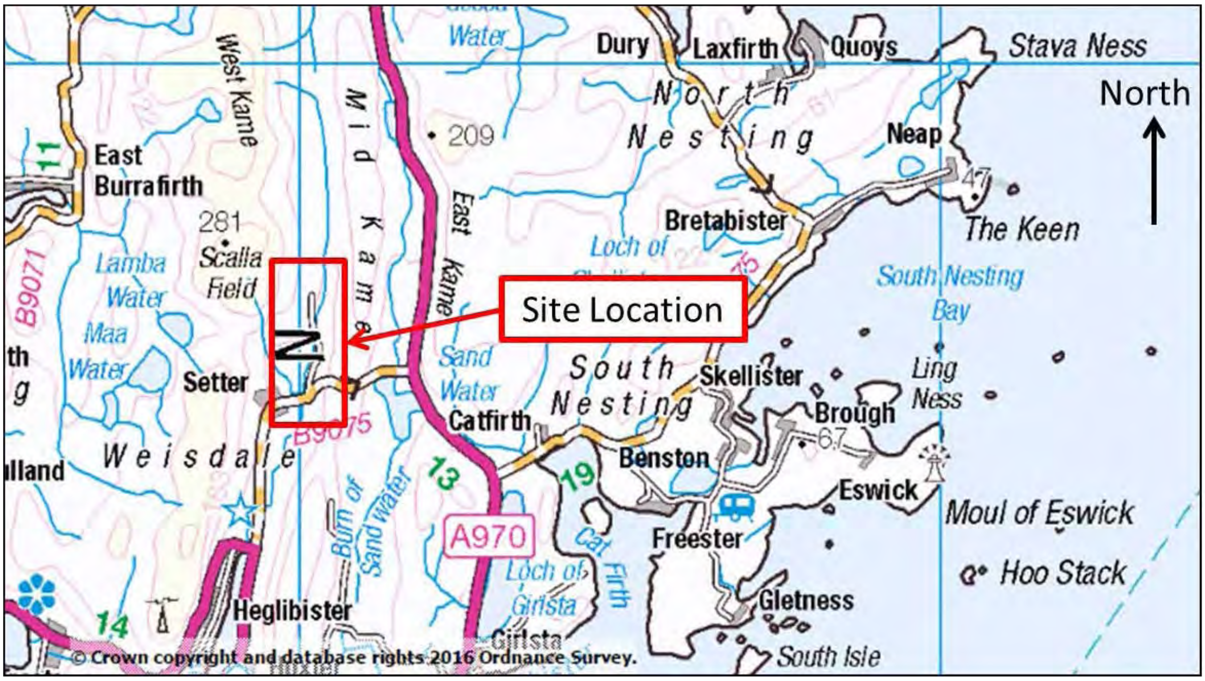

Figure 1-1: Extract from the Ordnance Survey OpenData Viewer of the Shetland Mainland (1:250,000 Scale)[23].

Across the site, the topography generally comprises undulating topography with numerous mounds and depressions in the north and gentle slopes in the south. A converter sub-station will be located at the northern end of the proposed development in a relatively flat area at the base of the valley (not discussed in this report). The elevation of the proposed development ranges from approximately 24m above Ordnance Datum (AOD) near the junction with the B9075, Sandwater Road in the south, to a peak elevation of 97m AOD in the north.

The proposed re-alignment branches from the existing B9075, Sandwater Road, at National Grid Reference HU 402 549. The alignment of the proposed development will cross the main river of Burn of Weisdale and its tributaries, including the Burn of Droswall.

For the purpose of description, the site is considered as four sections of common character, with the extents of each section indicated on the sketch plan shown in Figure 1-2. The Desk Study in Section 2 follows the same convention of zones. The general description of each area is as follows:

A. The alignment of the proposed development passes through open land used for sheep grazing on the gently sloping eastern valley side then crosses over the existing Upper Kergord track and the Burn of Weisdale.

B. The alignment of the proposed development passes through open land over a low-lying broad ridge and into the narrow, ‘v-shaped’ valley along the Burn of Droswall.

C. The alignment of the proposed development passes along the western valley side, which has steep slopes with frequent small streams. This area appears to have been used historically as crofting land.

D. The alignment of the proposed development passes through crofting/agricultural land with short grassed area.

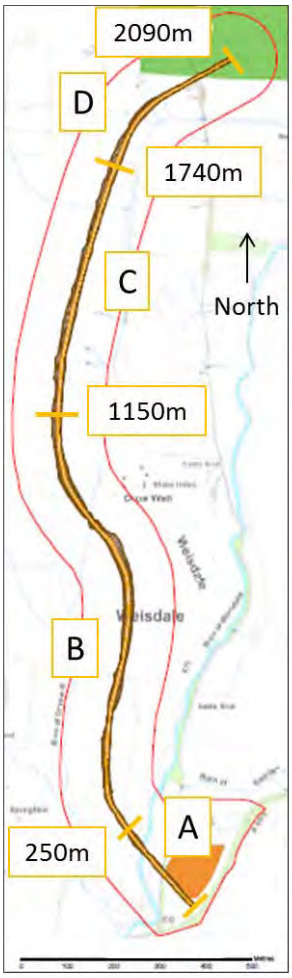

Figure 1-2: Diagrammatic plan above showing the proposed alignment of the Kergord Access Track, divided into four areas of common landscape character[26].

1.5 Proposed Construction

Preliminary work provided by VEWF shows the proposed construction along the Kergord Access Track comprising of general earthworks, with a bridge crossing anticipated at the Burn of Weisdale and a large culvert at the Burn of Droswall. The provisional cutting depths and embankment heights, relative to existing ground level, have been estimated from the proposed construction drawing[18], and are summarised in Table 1-1 at 100m chainage intervals, commencing from the junction with the B9075. VEWF have shown earthwork slope gradients of 1V:2H (27degrees) for both embankment and cutting slopes[15/16]. It is anticipated, however, that permanent cutting slopes of circa 1V:4H would be necessary in order to maintain stability of the slopes in the long term.

Chainage		Proposed Earthworks Relative to Existing Ground Level Works**	
From	To	Typical Cutting Depth*	Typical Embankment Height
0	100	1.1	-
100	200	1.7	1.6
200	300	1.5	-
300	400	2.1	-
400	500	1.8	-
500	600	2.8	-
600	700	2.6	-
700	800	3.3	-
800	900	3.2	-
900	1000	1.9	3.2
1000	1100	1.8	-
1100	1200	2.3	-
1200	1300	2.3	-
1300	1400	2.6	-
1400	1500	2.3	-
1500	1600	1.9	-
1600	1700	2.0	-
1700	1800	2.4	-
1800	1900	2.2	-
1900	2000	0.8	-
2000	2090	0.7	-

Table 1-1: VEP Proposed Earthworks.

Note: *The cutting depth excavation is to finished road level only and does not allow for road pavement construction.

**The earthworks depths/heights are stated relative to existing ground level, the actual earthworks construction will be different. VEWF proposes to remove the full thickness of peat and to support the highway upon the underlying competent stratum. Accordingly, excavation depths cannot be inferred from this information

*** The proposed site compound area is to be installed immediately east of the Kergord Access Track as temporary works between chainage 0m and chainage 100m with an maximum peat depth of 0.62m and an average peat depth of 0.44m.

The proposed construction drawing[18] shows cuttings along the majority of the route, with two short sections of approach embankments for crossing the Burn of Weisdale and the Burn of Droswall. Earthwork cutting depths and embankment heights in Table 1-1 are relative to existing ground level, but will entail the excavation and removal of peat to full thickness throughout the route.

2. Desk Study

2.1 Site History and Land Use

Online records ('old-maps.co.uk' [7]) show the site has remained as a mix of open land and crofting land from publication of the earliest edition map, in 1880, to present day. Two lime kilns and a 'well' are shown on 1880 to 1902 edition maps, alongside the Upper Kergord Track, approximately 30m east of the proposed track alignment. No other significant land use changes are apparent.

2.2 Aerial Photographs

Reference has been made to aerial photography[3] and from online sources (e.g. *google.co.uk/maps* and *bing-maps.com*[8]). Variations in soil saturation and vegetation are clearly visible from the aerial photographic images. Accordingly, crofters have made best use of the land that naturally drains more effectively, within Upper Kergord, and open moorland towards the southern end of the development area.

2.3 Geology

The geological setting of the site area has been assessed with reference to the British Geological Survey mapping for the area. Geological Survey of Scotland maps for Central Shetland, Sheet 128 (1:63,360) Solid edition, 1981, and Drift edition, 1982[6], are summarised below. The anticipated stratigraphy for the area is peat overlying Glacial Till onto Bedrock. Reference has also been made to the Soil maps of Scotland (1:250,000) prepared by the Macaulay Institute for Soil Research 1981[17]. The superficial geology and solid geology descriptions below are sub-divided into four areas along the Kergord Access Track (refer to Section 1.4 for the area extents).

2.3.1 Superficial Deposits and Made Ground

Superficial deposits comprise mainly of blanket peat deposits with small outcrops of Glacial Till recorded across the site. There are isolated sections of the track that are likely to have minimal or no superficial deposits (e.g. river crossings). Made Ground and hardstanding is anticipated along the existing Upper Kergord Track.

A. Peat deposits, river Alluvium and Glacial Till. The Alluvium is associated with the Burn of Weisdale.

B. Blanket peat deposits with small areas of river Alluvium.

C. Peat deposits, with a small area of Glacial Till recorded in the northernmost part of this section.

D. Glacial Till is recorded along this section.

2.3.2 Solid Geology

The solid geology along the track generally comprises the Scatsta Quartzitic Group to the north-west and the Weisdale Limestone to the south-east. There is an inferred geological boundary between the two groups, which indicates the younger meta-limestones in the east lie conformably over the older meta-quartzite. The strata has been subjected to folding with vertical or near vertical bedding recorded. There is stretching-lineation recorded within the solid geology, aligned with the regional Nesting Fault zone, approximately orientated north-south.

A. Quartzite and gritty quartzite with semipelitic granulite and crystalline limestone with calc-silicate bands – plunge of lineation within the quartzite is c.10 degrees to the north.

B. Crystalline Limestone with calc-silicate bands – vertical layering and bedding.

C. Crystalline Limestone with calc-silicate bands and Quartzite interbanded with semi-pelitic and pelitic schist - vertical layering and bedding.

D. Crystalline Limestone with calc-silicate bands and Quartzite interbanded with semi-pelitic and pelitic schist - vertical layering and bedding.

There is a vertical 'strike-slip' fault (dextral movement) located approximately 300m at its nearest point to the south-west of the site, orientated north-west – south-east. Lamprophyre dykes (igneous) are potentially intruded within the Weisdale Limestones, and are likely to have developed post depositional and folding. Dykes may seal off pathways for groundwater flow, and alter the engineering behaviour of rocks around the contact zone.

2.4 Topography

The regional topography is dominated by north-south trending ridges and valleys, which are governed by the solid geology. The Kergord Access Track will be located along the Valley of Kergord with an elevation ranging from 24-100m AOD, roughly following the Burn of Weisdale. The Mid Kame ridge is located to the east of the site and West Kame ridge to the west of the site. A dominant local hill, named Scalla Field, rises to the west of the West Kame ridge. There is a low-lying broad ridge along the base of the valley, separating the Burn of Weisdale and the Burn of Droswall.

The topography for the alignment of the Kergord Access Track (refer to Section 1.4 for further details and extents of the four areas) is generally as follows:

A. Gentle slope down towards the Burn of Weisdale. Ground is fairly level across the existing Upper Kergord Track and the Burn of Weisdale, which potentially is a localised floodplain area.

B. Undulating topography with numerous mounds and depressions, confined by small slopes down to the Burn of Weisdale and the Burn of Droswall. A cluster of 'shake holes' (sink holes) are located near the track alignment to the north east, potentially associated with karst limestone dissolution or collapsed peat pipes.

C. Long straight uninterrupted western slope, with occasional mounds and frequent gullies.

D. Fields along the northern section of the track have gently sloping and relatively flat sections.

2.5 Hydrology and Hydrogeology

The Burn of Weisdale is the main river through the Valley of Kergord, discharging approximately 3km downstream into the Weisdale Voe estuary. The burn flows along the valley floor, in a southerly direction. A tributary, known as the Burn of Droswall, runs parallel and circa 20m above the Burn of Weisdale through most of the valley, intercepting spring flows that emerge from the West Kame ridge. There are numerous minor tributaries (e.g. Burn of Swirtars) that flow down the western and eastern slopes, which converge with the main rivers along the base of the valley. Crofting land to the north of the route has a series of drainage ditches, which run diagonally across the fields, discharging into the Burn of Weisdale.

The site is underlain by crystalline rocks, which are generally considered to have limited groundwater capacity except at shallow depth. However, there is evidence of springs emerging through the western flank of the valley, which are likely to be fed by groundwater from Scalla Field.

The groundwater flow within peat is considered as a diffusive process and as a result bodies of peat may store water and release it continuously within a catchment, for long periods following a rainfall event. However, run-offs from some peatlands can be 'flashy' with short lag times following storm events.

The hydraulic conductivity of peat is highly variable, and tends to decrease with increasing degree of humification and depth (e.g. permeability decreasing from fibrous to amorphous peat). This decrease in permeability can be attributed to the decomposition of plant materials, resulting in a reduction of available pore space.

Preferential drainage pathways commonly form within bodies of peat due to internal erosion. These pathways, known as peat pipes, enable the rapid drainage of peat following a flood event. Peat pipes may grow to such size that the peat can no longer bridge across the void and the pipe collapses. A depression or hole, known as a hag, may be formed when the void from a collapsed peat pipe migrates to the ground surface. The collapse of peat pipes will lead to the localised build-up of porewater pressure and this may initiate peat instability.

The Ordnance Survey (OS) base map shows a cluster of 'shake holes' (sink holes) located adjacent the track. These shake holes could represent either karst topography or collapsed peat pipes.

2.6 Geomorphology

Steep slopes along the Valley of Kergord to the east and west have been created by glaciation and the regional glacial flow direction was westwards. The Burn of Weisdale and Burn of Droswall have cut shallow 'v-shaped' gullies into the base of the valley floor creating a broad, low-lying, intermediate ridge.

The initial site reconnaissance, undertaken in September 2013, encountered relict peat slides, peat pipes and peat depressions on the intermediate ridge between the Burn of Droswall and Burn of Weisdale. There are several peat scars, minor compression ridges and peat pipes along the western valley slope. A natural break in slope was identified along the western valley side, with occasional boggy ground associated with stream heads, and occasional collapsed peat pipes close to the proposed development.

2.7 Receptors

The principal receptors that could be susceptible to damage from a peat slide event include:

- Upper Kergord properties and adjoining fields;
- the existing Upper Kergord Track that connects the B9075 with the Upper Kergord properties;
- Burn of Weisdale and Burn of Droswall water courses. Downstream of the site there are road bridges and foot bridges crossing the Burn of Weisdale, and a weir associated with Weisdale Mill. The Burn of Weisdale leads to the Weisdale Voe estuary;
- minor water courses/water bodies; and
- natural ecological habitats along the proposed development alignment[19/25].

3. Site Reconnaissance and Fieldwork

3.1 Site Reconnaissance

An initial site reconnaissance was undertaken by Jacobs in September 2013. The 2013 walkover survey was undertaken in relation to an earlier route alignment, which has since been superseded in part, and was undertaken concurrently with the peat investigation for the adjacent B9075 Sandwater Road project. The proposed development has subsequently been modified, particularly along the southern section that was not included within the coverage of the 2013 site reconnaissance.

The proposed site compound area has not been inspected; therefore, hazard scores have been assigned based on the adjacent section of the Kergord access track.

The aim of the site reconnaissance was to zone the site into areas with similar landscape character and geomorphology, and to identify features that may be indicative of ongoing peat instability, e.g. hags, breaks-in-slope, drainage channels, gullies and relict instability features. Photos and descriptions of relevant features observed during the 2013 reconnaissance survey are presented as Appendix B. The site reconnaissance encountered the following key hazards:

A. Various historic back scars and peat lobes evident along the eastern valley slope.

B. Relict peat slides, peat pipes and a large peat depression on the intermediate ridge between the Burn of Droswall and Burn of Weisdale.

C. There are several peat scars, minor compression ridges and occasional peat pipes along the western valley slope. A natural break in slope was identified along the western valley side, with occasional boggy ground associated with stream heads.

D. Areas of saturated, boggy ground. Low lying crofting land has drainage ditches that cross the site.

3.2 Ground Investigation Fieldwork

Ground investigation fieldwork was undertaken in four phases, under the direction of VEWF. The four ground investigations cover different areas and were undertaken in 2009, 2013, 2015 and 2016. Figure C3 in Appendix E shows the coverage of the 2013, 2015 and 2016 ground investigations. Figure 3-1 shows typical peat thicknesses recorded by relevant peat probes from the three latest investigations for the proposed development.

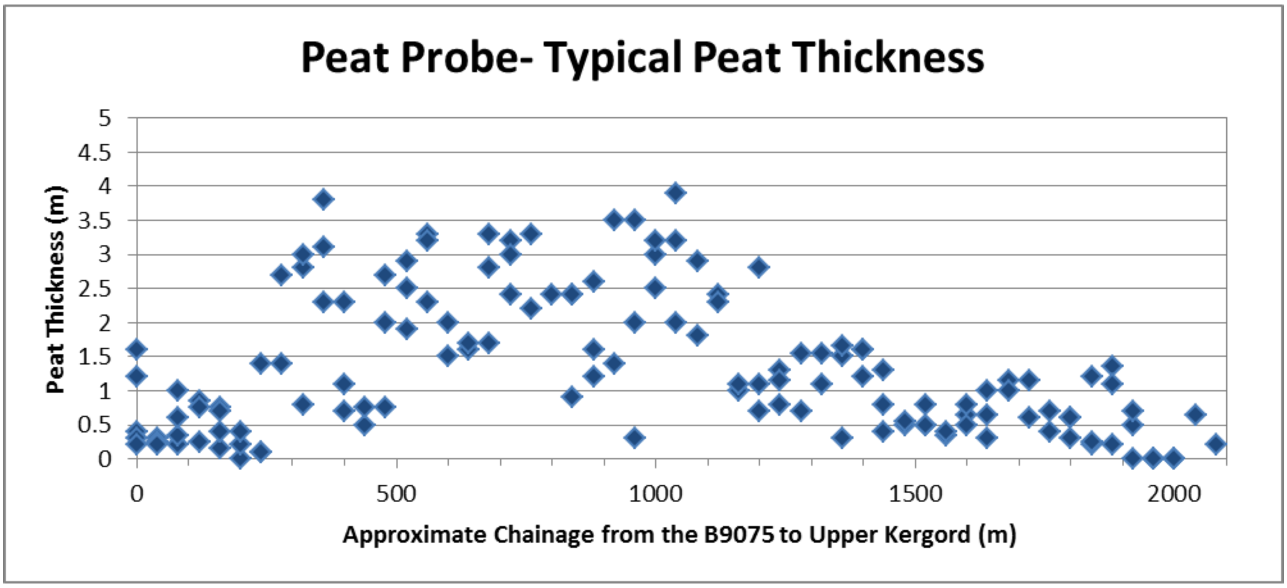

Figure 3-1: Typical peat thicknesses recorded along the proposed development.

3.2.1 Peat Investigation 2009 – Mouchel Ltd

The Viking Peat Stability Assessment report[1] summarises the findings of a peat probe investigation undertaken by Fugro, who was contracted by Mouchel, to survey the whole wind farm development. The access corridors investigated during the 2009 survey were different to that currently under consideration, but there are short sections where the routes coincide. Figure 3-2 indicates the depth of peat probes sunk as part of the 2009 survey. Probe holes were terminated once a marked change in resistance was observed, indicating the presence of dense material underlying the peat. Peat probes ranged in depth along the investigation corridor, with the greatest thicknesses of peat (>2.5m below ground level) typically encountered in the southern half, which corresponds approximately to chainage 300 to 1100 on the latest proposed development alignment.

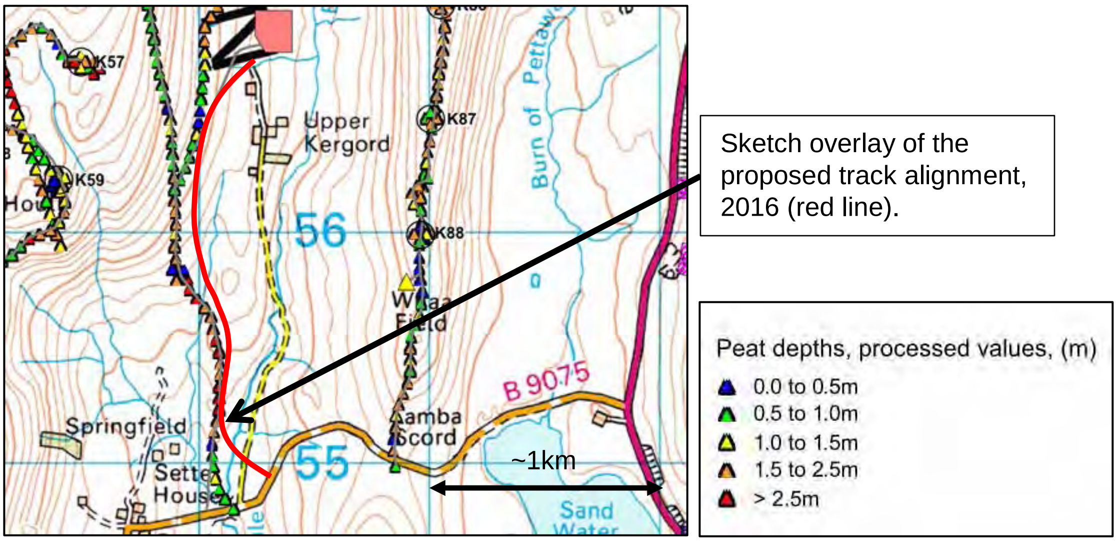

Figure 3-2: Extract from the Viking Peat Stability Assessment report (Mouchel 2009[1])

3.2.2 Peat Investigation 2013 – Raeburn Drilling and Geotechnical Limited

A ground investigation was undertaken at the site in September 2013 under the direction of VEWF. Peat probing and Russian coring was carried out by Raeburn Drilling and Geotechnical Ltd along a previously proposed alignment of the Kergord Access Track[10/12]. Reference should be made to the peat probing location plans for the 2013 ground investigation presented within Appendix E[12]. The investigation fieldworks comprised:

- 52 No. probe holes sunk at 40m centres along the centre line of the proposed development as it was at that time (2013), taken to termination depths of 0.1 – 3.9m. Refer to Appendix C for probe depths and co-ordinates.

- 83 No. probe holes sunk at 50m centres, offset approximately 20m to either side of the centreline along the proposed development as it was at that time, taken to termination depths of 0.1 – 3.8m. Refer to Appendix C for probe depths and co-ordinates.

- 24 No. cores at 80m centres, along the proposed development as it was at that time, taken to termination depths of 0.4 – 3.0m. Refer to Appendix D for peat core logs.

Peat coverage was commonly noted to be thinner on the steeper northern slopes and in land adjacent to the B9075 and the existing Upper Kergord Track.

Peat cores were taken by Raeburn Drilling Ltd to obtain samples for laboratory testing and classification using the von Post method, in accordance with SEPA guidance[4]. The peat core samples were not scheduled for testing at the time of the investigation; however the descriptions of recovered peat samples have been used to inform aspects of the peat slide assessment. The classification by von Post method is summarised in Table 3-1.

Degree of Humification	Decomposition	Plant structure	Content of Amorphous Material	Associated extrusion
H1	None	Easily identifiable	None	Clear, colourless
H2	Insignificant	Easily identifiable	None	Yellowish
H3	Very slight	Still identifiable	Slight	Brown, muddy
H4	Slight	Not easily identified	Some	Dark brown, muddy
H5	Moderate	Recognisable but vague	Considerable	Muddy with some peat
H6	Moderately strong	Indistinct	Considerable	Dark brown with peat
H7	Strong	Faintly recognisable	High	Dark brown with peat
H8	Very strong	Very indistinct	High	Uniform peat paste
H9	Nearly complete	Almost recognisable	High	No free water
H10	Complete	Not discernible	High	No free water

Table 3-1 : Von Post Classification

The moisture content of peat is estimated on a scale of 1 (dry) to 5 (very high), designated as B1 to B5 and this is used in combination with the von Post classification to characterise peat. It should be noted that the moisture content value is assessed by the logging engineer through experience with peat samples. The Moisture Content Classification is shown in Table 3-2.

Grade	Moisture Content
B1	Dry peat
B2	Low moisture content
B3	Moderate moisture content
B4	High moisture content
B5	Very high moisture content

Table 3-2 : Moisture Content Classification

The composition of peat bodies typically varies with depth, and two distinct zones may be considered to form in peat bodies – an upper Acrotelm layer and a lower Catotelm layer. The characteristics of the two zones are described below.

- Acrotelm – This layer comprises decomposing peat that lies above the average water table and is of relatively high permeability. It is typically a fibrous peat with low levels of humification. The Acrotelm can be up to 1.0m in thickness, but can be thicker under dry conditions. This layer is typically scored between H1 to H5 on the von Post classification and typically has greater water content (e.g. B4 and B5).
- Catotelm – This layer consists of dense, compact peat that is permanently saturated and lies below the water table. The upper surface of the Catotelm is typically found at depths of 1.0m – 1.5m below ground surface, with its base defining the bottom of the peat mass. This layer comprises pseudo-fibrous to amorphous peat. This layer is typically scored as H6 to H10 on the von Post classification scale.

Figure 3-3 shows the respective thicknesses of the Acrotelm and Catotelm layers at peat core locations from 2013 investigation that are relevant to proposed development. Figure 3-4 shows the moisture content of the peat samples extracted within the peat cores from the 2013 investigation that are relevant to proposed development.

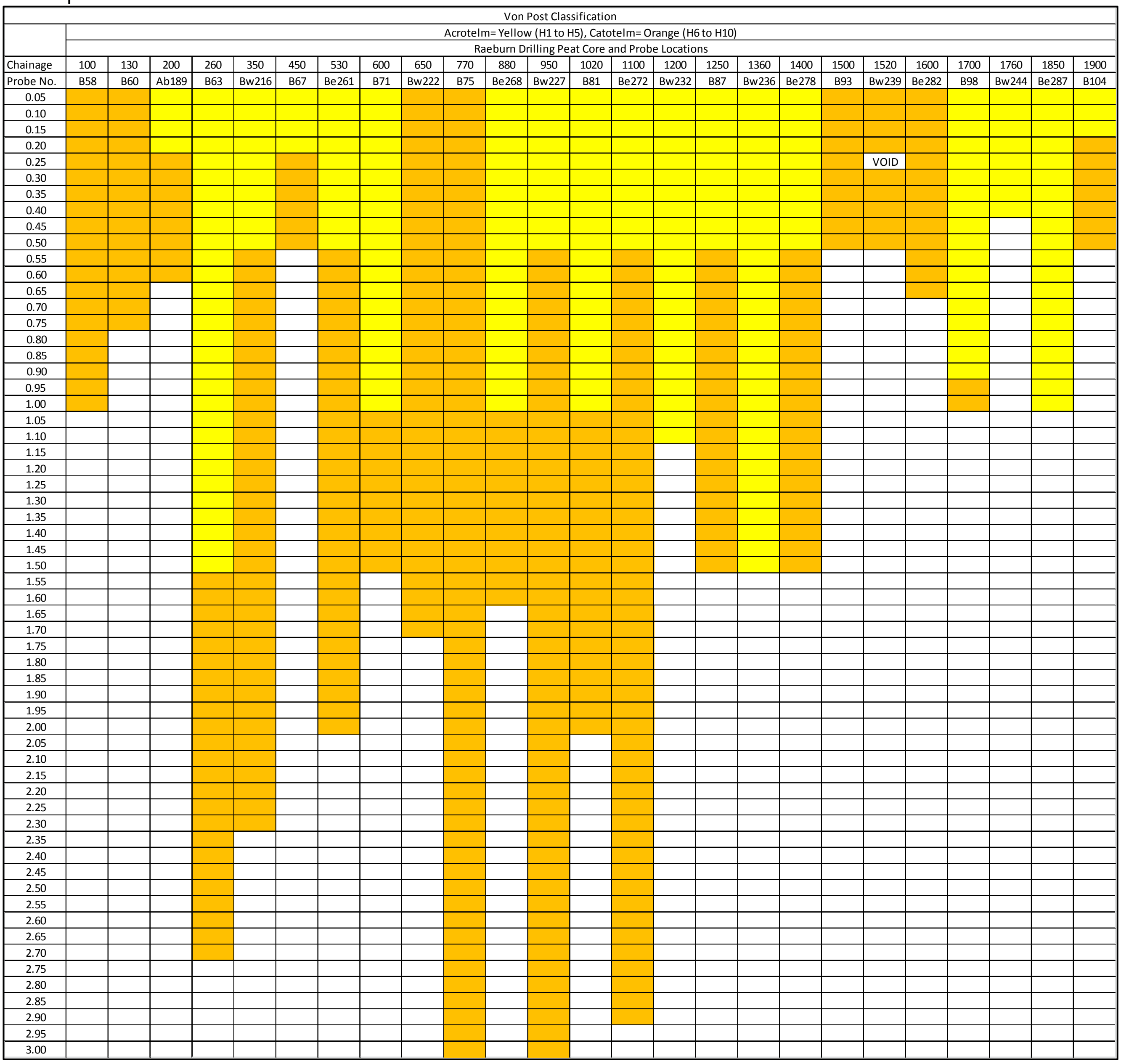

Figure 3-3: Acrotelm (highlighted yellow) and Catotelm (highlighted orange) depth ranges at peat core locations across parts of the Kergord Access Track. Peat core data taken from the 2013 ground investigation[10].

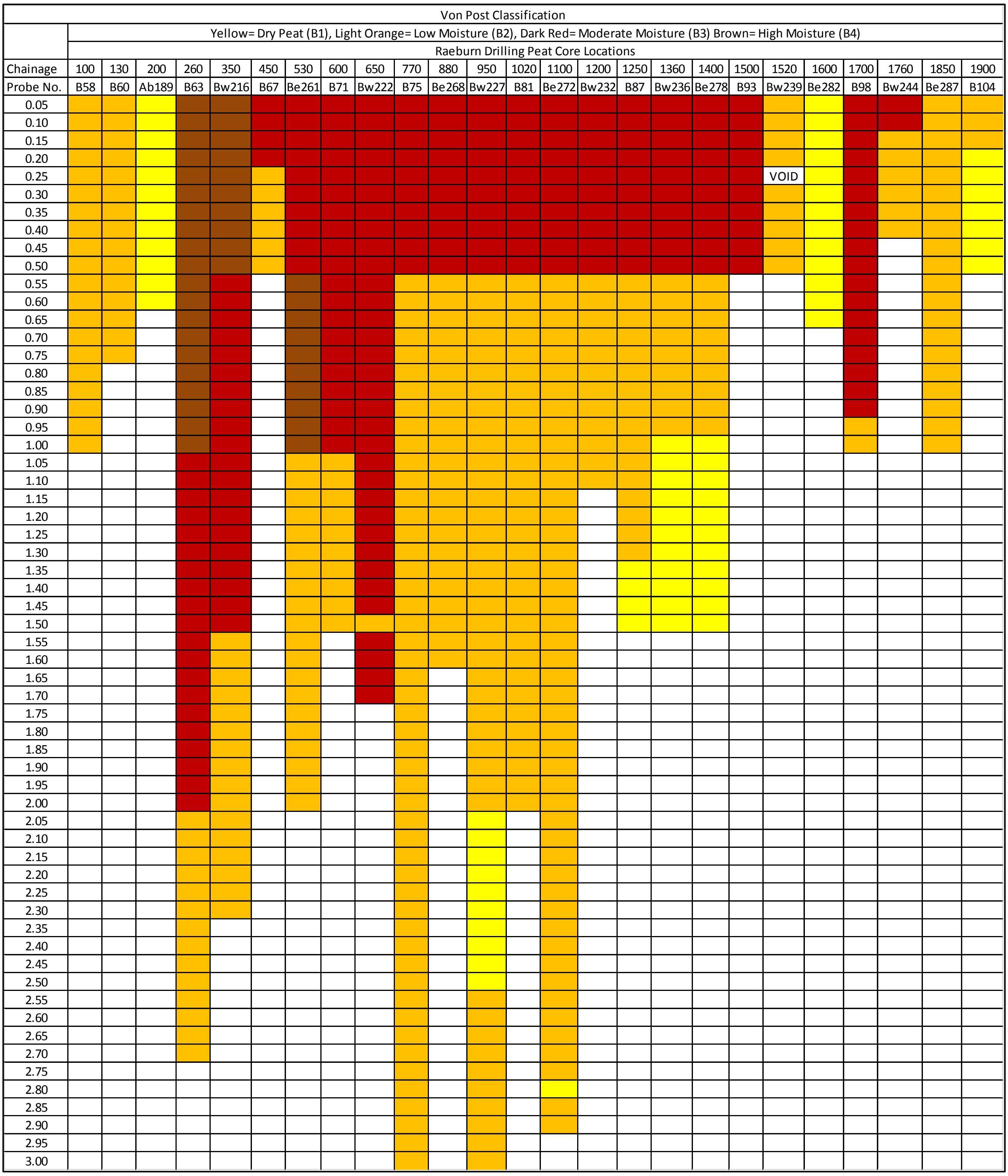

Figure 3-4: Moisture content class (B1 highlighted in yellow, B2 highlighted in light orange and B3 highlighted in orange) of peat samples recovered across the Kergord Access Track. Peat core data is taken from the 2013 ground investigation[10].

3.2.3 Peat Investigation 2015 – RPS Group Limited

A ground investigation was undertaken by RPS Group in November 2015[11], under the direction of VEWF, covering three sections of the proposed development outlined below. The 2015 investigation also covered the potential enabling works compound area adjacent to the B9075 and the western slope adjacent to the proposed sub-station (outwith this report). Reference should be made to the peat probe location plans for the 2015 ground investigation presented within Appendix E[11]. Peat probes were terminated once a marked change in resistance was observed, which would indicate the presence of dense material underlying the peat. The works included:

- 197 No. probe holes sunk on a square grid at 20m centres, taken to termination depths of 0.05m – 3.22m for land adjacent to the proposed sub-station and a small extension of the track in the north, which are in close proximity to chainage 1650 to 2090 on the proposed development. Refer to Appendix C for probe depths and co-ordinates.

- 37 No. probe holes sunk at 50m centres along the centre line of the 2015 track alignment in the south, taken to termination depths of 1.81m – 3.01m, which approximately correspond to chainage 350 to 900 on the proposed development. Refer to Appendix C for probe depths and co-ordinates.

- 206 No. probe holes sunk on a square grid at 20m centres, taken to termination depths of 0.38m – 3.62m for a potential enabling works compound, which approximately correspond to chainage 0 to 550 on the proposed development. Refer to Appendix C for probe depths and co-ordinates.

3.2.4 Peat Investigation 2016 – RPS Group Limited

A ground investigation was carried out in March 2016 by RPS comprising 204 peat probes[24], under the direction of VEWF. Reference should be made to Appendix E for a location plan of the peat probes. This investigation was undertaken as a wider general assessment of route options and to fill any potential gaps in the peat probe records along the proposed development. Additionally, peat probes (88No.) were carried out to the north-west of the site along a potential corridor for accessing the wind farm development, which are outside the scope of this report.

- 116 No. probe holes sunk at 50m centres alongside proposed development or in areas for the wider assessment of route options, taken to termination depths of 0.3m – 5.1m. These probes correspond approximately to chainage 0 to 850 and 1050 to 2090. Refer to Appendix C for probe depths and co-ordinates.

4. Peat Landslide and Hazard Assessment

This peat slide assessment will consider and categorise the risk of peat instability under existing conditions. The proposed development will influence the likelihood of peat instability. The construction works are likely to give rise to an increase in peat slide risk through the following:

- the removal of lateral support during excavation and removal of peat to full thickness;
- the obstruction or alteration of existing drainage pathways through the peat mass, leading to localised increases in pore water pressure; and
- the creation of tension cracks in the peat due to pressure relief, which may subsequently allow rain and snow melt water to percolate into the peat mass, and trigger instability.

4.1 Methodology of Hazard and Risk Assessment

Risk of instability has been assessed with reference to the Scottish Executive guidance[4] (December 2006), using the available data from the desk study, site reconnaissance and site investigations. This initial assessment procedure is a pseudo-quantitative assessment, based on the assignment of hazard scores for a number of factors that are known to contribute to instability in peat. Research[20/21] has established that the two primary factors that make a peat mass more susceptible to sliding failure are the surface slope angle and the thickness of the peat deposit. Peat deposits greater than 1m thick are likely to have a developed layer of saturated amorphous peat, known as catotelm, which can represent a zone of weakness within the peat mass. Ground surface sloping at angles as shallow as 5° (8.7%) can give rise to out of balance forces within the peat that can drive movement. Other environmental and man-made influences may exacerbate the risk of failure where the two primary risk factors exist together.

Primary factors:

- surface slope angle; and
- peat thickness.

Secondary factors:

- sub-stratum and peat interface;
- peat strength;
- hydrology;
- evidence of peat instability; and
- rainfall and climate.

For any given location along the proposed development, scores are assigned in respect of each contributory factor ('likelihood of failure' terminology based on MacCulloch[21]), based on factual evidence. An overall susceptibility score is then derived by multiplying the sub-scores for each factor together. Where a hazard is not considered to adversely affect stability of the peat mass, that factor is assigned a score of one, and will have a neutral impact on the overall susceptibility score.

Susceptibility scores have been derived for each chainage block (100m intervals). The highest score for each factor has been adopted where there is an absence of supporting information and where further investigation and analysis are required.

A simple scoring system has been developed in accordance with the PLHRA Scottish Executive guidance[4] to determine susceptibility and exposure ranks along the proposed development. The score is determined as follows:

Overall Peat Slide Score = Susceptibility Score x Exposure Score

- Susceptibility Score is defined as the possibility or likelihood of a peat failure event occurring within the site;

- Exposure Score is defined as the impact that this event may have within the site;
- Overall Peat Slide Score is determined by multiplying the above two scores together. This score is intended as a means of comparing different sites and as a tool for prioritising mitigation.

4.2 Factors Influencing Susceptibility to Peat Failure

4.2.1 Surface Slope Angle

Surface slope angles have been derived using a topographical plan derived from converted LiDAR data[3]. Research indicates that failures have occasionally occurred on slope angles as low as 4°, with progressively increasing susceptibility as the slope angle increases[20/21]. Whilst peat is known to have failed on relatively gentle slope angles, areas of level ground are considered to have a lower likelihood of failure as there is no gravitational driver to facilitate movement. Peat is typically absent from slopes steeper than 15°, or at least present at shallow thickness. Areas with steep slopes ≥15° are generally located alongside incised stream channels. The hazard score system developed for surface slope angle is presented in Table 4-1.

Slope Angle	Score	Likelihood of failure
Slope < 5^o	1.0	Unlikely/ Negligible
$5^o \leq$ Slope < 10^o	2.0	Possible
$10^o \leq$ Slope < 15^o	2.5	Likely
Slope ≥ 15^o	3.0	Very Likely

Table 4-1: Surface Slope Angle Hazard Score System

4.2.2 Peat Thickness

Ground investigations at the site proved peat to thicknesses of up to 3.9m. For the hazard score system, four thickness ranges have been considered. Research states that susceptibility typically increases with peat thickness greater than 1m, based on a single layer profile[20/21]. The hazard score progressively increases with peat thickness, as peat deposits in excess of 1m thick are likely to have developed a saturated and amorphous catotelm layer, which is likely to represent a weak layer within the peat mass. The hazard score system developed for peat thickness is presented in Table 4-2.

Peat Thickness	Score	Likelihood of failure
Peat < 1.0m	1.0	Unlikely/ Negligible
1.0m ≤ Peat < 1.5m	2.0	Possible
1.5m ≤ Peat < 2.0m	2.5	Likely
Peat ≥ 2.0m	3.0	Very Likely

Table 4-2 : Peat Thickness Hazard Score System

4.2.3 Sub-stratum and Peat Interface

The sub-stratum and peat interface factor has been divided into four categories and is based on published literature[20]. This factor is governed by the type of sub-stratum and the degree of roughness. The gradient of the interface is not considered within this factor. Sub-stratum was not examined during the ground investigations and there were limited outcrops observed during the site reconnaissance. Therefore a conservative score of 2.0 was adopted across the site, by default, pending further investigation. The hazard score system for peat sub-stratum and interface is presented in Table 4-3.

Sub-stratum and Peat Interface	Score	Likelihood
Rough and irregular rockhead or granular subsoil of sand and gravel	1.0	Unlikely/ Negligible
Undulating rockhead or granular subsoil	1.5	Possible
Planar and regular rockhead or cohesive subsoil	2.0	Likely
Smooth, polished and regular rockhead or cohesive subsoil of clay	2.5	Very Likely

Table 4-3 : Sub-stratum and Peat Interface Hazard Score System

4.2.4 Peat Strength

The peat strength factor is divided into four categories, based on research by Nichol, 2006[20]. Peat strength is calculated from in-situ shear vane tests. The 2009 investigation[1] included four boreholes with in-situ shear vane tests, distributed across the proposed wind farm site. These tests recorded undrained cohesive shear strengths of up to 35kPa within the upper parts of the acrotelm strata (<0.5m bgl). Typical undrained cohesion values of less than 23kPa were recorded from 0.5m to 1.0m bgl. The 2013, 2015 and 2016 investigations did not undertake shear vane tests and, in the absence of factual data to justify a more optimistic score, a default score of 2.5 has been adopted for the access track. The hazard score system is provided in Table 4-4.

Peat Strength	Score	Likelihood
Shear Vane 40kPa	1.0	Unlikely/ Negligible
Shear Vane 30kPa	1.5	Possible
Shear Vane 20kPa	2.0	Likely
Shear Vane 10kPa	2.5	Very Likely

Table 4-4: Peat Strength Hazard Score System

4.2.5 Hydrology

Surface hydrology features and other indicators of ground saturation were identified during the site reconnaissance, on the OS base map and aerial photography. The OS base plan identified ‘shake holes’ (sink holes) immediately upslope and upstream of the main central cutting, which could represent collapsed peat pipes or karst topography. Variations in the types of vegetation can also be used as an indicator of peat saturation. Vegetation typically ranged from heather/grass on the far eastern and western valley sides, to reeds/mosses in the saturated lower ground of the valley. Peat slides can be triggered along natural drainage lines where a high moisture content increases the likelihood of failure, potentially charged by groundwater springs or via karst features. Saturated areas may reduce the natural strength of the peat and increase the pore water pressure, hence increasing the likelihood of failure. Relatively well drained, drier areas are considered less susceptible to failure. The hazard score system for hydrology is presented in Table 4-5.

Hydrology	Score	Likelihood
None Evident	1.0	Unlikely/ Negligible
Occasional	1.5	Possible
Frequent	2.0	Likely
Many	2.5	Very Likely

Table 4-5 : Hydrology Hazard Score System

4.2.6 Evidence of Peat Instability

Isolated areas of historical or on-going instability were identified on or near the proposed track alignment during the 2013 site reconnaissance and with the desk study records. On the large plateau between the two water courses (Burn of Weisdale and Burn of Droswall) and at other isolated areas, there was evidence of erosion, creep and localised scarps. However, there are sections along the new alignment that could be developed with additional site reconnaissance. This factor is based on the frequency[20/21] of natural and man-made features that could indicate historical instability or precursors to peat instability across the site. Areas with breaks-in-slope, erosion, creep, man-made cuttings etc. typically associated with a higher risk of peat slides developing. The hazard score system for evidence of peat instability is presented in Table 4-6.

Evidence of Peat Instability	Score	Likelihood
None Evident	1.0	Unlikely/ Negligible
Occasional	1.5	Possible
Frequent	2.0	Likely
Many	2.5	Very Likely

Table 4-6 : Evidence of Peat Instability Hazard Score System

4.2.7 Rainfall and Climate

Increased rainfall may be a significant trigger for peat slides, potentially surcharging any peat pipes within the ground, resulting in the build-up of excess pore water pressures. Rainfall may also lead to localised flooding events along the main burns that have large catchment areas. These localised flood events could also cause destabilising effects in the peat deposits. Landslides typically occur following the regression of flood waters, as excess porewater pressures may continue to exist within earth slopes above the fallen river. McCulloch[21] states that peat slides are more susceptible after periods of prolonged dry weather that may result in the formation of shrinkage cracks within the peat. Subsequent rainfall is able to percolate into the peat via such cracks, leading to the localised build-up of destabilising porewater pressures. The average annual rainfall has been determined as 1209mm by using rainfall records at Lerwick Weather Station[22]. A score of 1.5 (moderate precipitation) has been estimated using research by Nichol, 2006[20]. The hazard score system for rainfall and climate is presented in Table 4-7.

Rainfall and Climate	Score	Likelihood
Low to Moderate Precipitation	1.0	Unlikely/ Negligible
Moderate Precipitation	1.5	Possible
High Precipitation	2.0	Likely
Very High Precipitation	2.5	Very Likely

Table 4-7 : Rainfall and Climate Hazard Score System

4.3 Susceptibility Ranking and Assessment

Each of the hazards identified in Section 4.2 have been allocated a hazard score at 100m chainage intervals along the Kergord Access Track. The individual hazard scores can be multiplied together to estimate a peat slide susceptibility value as follows:

Peat Slide Susceptibility Value = Surface Slope Angle x Peat Thickness x Sub-Stratum and Peat Interface x Peat Strength x Hydrology x Evidence of Instability x Rainfall and Climate

The peat slide susceptibility score for each 100m chainage interval is then ranked as shown in Table 4-8. The peat slide susceptibility score ranges have been developed into a rank from 1 to 5 (very low to very high), in order to group and prioritise the potential likelihood of peat slide risk. The susceptibility score boundaries between each rank have been determined using a general site assessment and SEPA guidance[4].

Susceptibility Score	Rank	Likelihood
0 to 30	1	Very low
30 to 60	2	Low
60 to 120	3	Medium
120 to 240	4	High
> 240	5	Very High

Table 4-8 : Susceptibility Ranking

A matrix of hazard scores and susceptibility rank for each 100m chainage interval, starting at the southern end of the Kergord Access Track, is provided in Table 4-9. A border is shown between the primary and secondary factors, which acknowledges that if one or both primary factors are neutral (score of 1), there is potentially a negligible or low risk of failure.

Chainage		Peat Susceptibility Scores							Peat Slide Susceptibility Value	Peat Slide Susceptibility Rank
		Primary Factors		Secondary Factors						
		Surface Slope Angle	Peat Thickness	Sub-Stratum and Peat Interface	Peat Strength	Hydrology	Evidence of Peat Instability	Rainfall and Climate		
Kergord Access Track Alignment										
From	To	Score	Score	Score	Score	Score	Score	Score	Score	
0	100	2	1	2.5	2.5	1	2	1.5	37.5	Low
100	200	2	1	2.5	2.5	2.5	1.5	1.5	70.3	Medium
200	300	2	1	2.5	2.5	2	1	1.5	37.5	Low
300	400	2	3	2.5	2.5	1	2	1.5	112.5	Medium
400	500	2	1	2.5	2.5	1	2.5	1.5	46.9	Low
500	600	2	3	2.5	2.5	2.5	2.5	1.5	351.6	Very High
600	700	2	3	2.5	2.5	1.5	1.5	1.5	126.6	High
700	800	2	3	2.5	2.5	2.5	1	1.5	140.6	High
800	900	2.5	3	2.5	2.5	2	1.5	1.5	210.9	High
900	1000	3	3	2.5	2.5	2.5	2	1.5	421.9	Very High
1000	1100	2	3	2.5	2.5	1	1	1.5	56.3	Low
1100	1200	2.5	3	2.5	2.5	1	2.5	1.5	175.8	High
1200	1300	3	2.5	2.5	2.5	2	2.5	1.5	351.6	Very High
1300	1400	2	3	2.5	2.5	2	2.5	1.5	281.3	Very High
1400	1500	2.5	2	2.5	2.5	2	2.5	1.5	234.4	High
1500	1600	2.5	1	2.5	2.5	1.5	2.5	1.5	87.9	Medium
1600	1700	3	2	2.5	2.5	2.5	1.5	1.5	210.9	High
1700	1800	2.5	1	2.5	2.5	2	2.5	1.5	117.2	Medium
1800	1900	2	3	2.5	2.5	2.5	1.5	1.5	210.9	High
1900	2000	2	1	2.5	2.5	2.5	1.5	1.5	70.3	Medium
2000	2090	2	1	2.5	2.5	1	1	1.5	18.8	Very Low
Site Compound Area *(NB Chainage based upon Kergord access track alignment)*										
From	To	Score	Score	Score	Score	Score	Score	Score	Score	
25	100	2	1	2.5	2.5	1	2	1.5	37.5	Low
100	175	2	1	2.5	2.5	2.5	1.5	1.5	70.3	Medium

Table 4-9 : Susceptibility Hazard Scores

The results in Table 4-9 show an area of high to very high risk between chainage 500m to 1000m and an area of medium to very high between chainage 1100m to 2000m. Two smaller areas of medium risk are located between chainage 100m to 200m and between 300m to 400m. The remaining areas are assessed to be of very low to low risk of peat slide. These results are shown graphically in Appendix A. The approximate lengths of proposed track in different susceptibility zones are shown in Table 4-10.

Susceptibility	Length of Access Track (m)
Very low	90
Low	400
Medium	500
High	700
Very High	400

Table 4-10 : Susceptibility Assessment

4.4 Exposure Ranking and Assessment

Susceptibilities are translated into a risk assessment through the application of an exposure calculation depending on the sensitivity of receptors within the site. A qualitative assessment of exposure has been adopted, based on engineering judgement and a practical overview of site conditions. The main receptors that could be vulnerable to peat slides induced by the new construction include:

- **Watercourses within and surrounding the site.** An obstruction of an existing channel could serve to destabilise a much larger area within the Valley of Kergord. This is likely to result from construction of an embankment on peat, as the peat will consolidate, thus reducing hydraulic conductivity beneath the embankment. Consequently, an area of peat located upslope from an embankment is likely to become more saturated (less stable) following construction of an embankment. Conversely, formation of a cutting within peat is likely to initiate slope instability. A critical period will follow immediately after formation of the cutting, after which the peat will drain and consolidate, so increasing in shear strength. Peat fibres will decompose on prolonged exposure to air and the self-reinforcement effect will be lost over the medium to long term. Formation of the deep cutting (4m) and sidelong cutting may result in drainage of peat, both upslope and downslope of the cutting, as the cutting will serve as a drain. This may result in loss of habitat. Hydrological features such as burns/rivers have been considered as sensitive receptors for negative environmental impacts in the event of a peat slide.
- **Access tracks and public roads.** The main impact would be disruption to the residents or anyone using the tracks/roads, although access by the general public during construction will be restricted and managed by the Contractor.
- **Existing buildings and infrastructure.** There are residential properties and farm buildings that are located in Upper Kergord, at the northern end of the scheme that could be impacted by a peat slide.
- **Natural habitats.** An initial ecological assessment has identified one small highly dependent habitat midway along the route. Once the final ecological assessment is available then the exposure classification should be revised post submission (i.e. whether the peat moor itself is protected).

A developed exposure ranking system is shown in Table 4-11.

Proximity to Sensitive Receptor	Rank	Exposure
0m – 25m	5	Extremely high impact
25m – 50m	4	High impact
50m – 100m	3	Medium impact
100m – 150m	2	Low impact
>150m	1	Negligible impact

Table 4-11: Exposure Ranking and Distance from Sensitive Receptor.

An exposure score has been assigned to each 100m section of access track, commencing from chainage 0m, at the proposed junction with the B9075. These results are shown graphically in Appendix A.

4.5 Overall Peat Slide Ranking

The peat slide susceptibility and exposure ranking systems can be combined into an overall peat slide ranking. Table 4-12separates the overall peat slide scores into ranks, as a means of comparing different sections of the site and as a tool for prioritising risk reduction measures and mitigation works. This table is based on Scottish Executive guidance[4] (December 2006) and Scottish Environment Protection Agency[5] (SEPA) guidance (January 2012).

Combined Hazard and Exposure Score	Overall Peat Slide Ranking
21 to 25	Very High
11 to 20	High
6 to 10	Medium
2 to 5	Low
0 to 1	Very Low

Table 4-12 Peat Slide Ranking

A matrix of overall peat slide ranking for each 100m chainage block, starting at the southern end of the Kergord Track, is provided in Table 4-13.

Chainage		Peat Slide Susceptibility Rank	Peat Slide Susceptibility Rank	Exposure Rank	Overall Peat Slide Ranking	Risk Assessment Rank
Kergord Access Track Alignment						
From	**To**		**Score**	**Score**	**Score**	**Score**
0	100	Low	2	5	10.0	Medium
100	200	Medium	3	5	15.0	High
200	300	Low	2	4	8.0	Medium
300	400	Medium	3	3	9.0	Medium
400	500	Low	2	3	6.0	Medium
500	600	Very High	5	3	15.0	High
600	700	High	4	2	8.0	Medium
700	800	High	4	3	12.0	High
800	900	High	4	4	16.0	High
900	1000	Very High	5	5	25.0	Very High
1000	1100	Low	2	3	6.0	Medium
1100	1200	High	4	2	8.0	Medium
1200	1300	Very High	5	2	10.0	Medium
1300	1400	Very High	5	2	10.0	Medium
1400	1500	High	4	2	8.0	Medium
1500	1600	Medium	3	3	9.0	Medium
1600	1700	High	4	3	12.0	High
1700	1800	Medium	3	3	9.0	Medium
1800	1900	High	4	4	16.0	High
1900	2000	Medium	3	5	15.0	High
2000	2090	Very Low	1	5	5.0	Low
Site Compound Area *(NB Chainage based upon Kergord access track alignment)*						
From	**To**		**Score**	**Score**	**Score**	**Score**
25	100	Low	2	5	10.0	Medium
100	175	Medium	3	5	15.0	High

Table 4-13 : Exposure Ranking Score with Chainage

The alignment between chainage 0m to 2000m has been assessed as medium to high risk, with a section of very high risk located between 900m to 1000m. Between chainage 2000m to 2090m the site has been assessed as low risk.

5. Construction Methodologies and Control Measures

5.1 General

As identified in Section 4, there are localised sections along the alignment of the proposed development that are located within areas of high and very high peat slide susceptibility in the central part of the proposed Kergord Access Track.

The following section outlines construction methodologies and mitigation measures that could be adopted to reduce the overall peat slide susceptibility and subsequent risk of the proposed development.

5.2 Construction Methodologies

The primary form of mitigation is to avoid the areas of high and very high peat hazard altogether. However, there is limited space within the Valley of Kergord to adjust the alignment of the track to reduce the risk; therefore secondary mitigation must be implemented.

The following provides an indicative list of mitigation measures and construction methodologies that could be implemented to reduce the risk of overall peat slide susceptibility:

- The risk assessment and stability assessments will be updated and revised as design and construction progresses. This may involve additional geotechnical investigation and stability analysis including probing and coring, as required.
- Micro-siting the track will be carried out, where possible within required vertical and horizontal alignment tolerances, to areas of thinner peat and lower peat slide susceptibility.
- The typical embankment construction[16] does not yet detail the foundation conditions, which may involve either the prior removal of peat within the footprint or construction above the peat. Embankments built on top of peat could use staged construction, to allow peat to consolidate and gain in strength between lifts. The lower embankment fill layers will be formed using free-draining fill materials to encourage cross drainage. The use of 'floating road' construction will be avoided alongside the main water courses.
- Temporary stockpile locations are not yet defined and will be reviewed in the detailed design phase.
- There are deep cuttings that extend below the proven thickness of peat, provisionally shown at 1V:2H gradient. The nature of underlying superficial deposits, and level of rockhead have not yet been established in these areas. The peat deposits would not stand at 1V:2H and would need to be trimmed back from the crest of the cutting and the slope slackened to nearer 1V:4H. Elsewhere along the track there will be a minimisation of undercutting to peat slopes.
- Rockfill buttresses will be provided on the upslope to provide stability as required.
- The extent of and duration of excavations in peat will be minimised, i.e. by backfilling track material as soon as possible and by only opening short sections of excavation, rather than continuous unsupported slopes.
- A robust drainage design with reference to the typical drainage drawings[13] will be installed to minimise disturbance of current hydrology and generate areas of concentrated flow (particularly when crossing watercourses). Design of the embankment will provide hydraulic continuity beneath the track, using cross drains or similar.
- Drainage measures such as silt traps will be introduced to minimise sedimentation into natural watercourses (particularly where the access track is in areas of high susceptibility close to or crossing watercourses).
- Localised cut off trenches, settlement ponds or barriers at watercourses and crossings will be reviewed in advance by a Geotechnical Engineer.
- Monitoring systems may be installed as required. The system would need to provide adequate warning to enable evacuation or remedial actions to be taken. This may require real time monitoring by continuous total station surveying or inclinometers with real time data logging and computer controlled alarms.

- Continued maintenance of drainage systems and slopes will be undertaken, including methodologies to ensure that accelerated degradation and surface erosion of exposed peat does not occur.
- Development of emergency plan and procedures in the event of a slide.

The above list is not exhaustive and a detailed geotechnical design of particular sections of access track section will be completed during the pre-construction phase under the management of VEWF.

Construction Methodologies will be based on the location-specific mechanical characteristics of the peat deposits and morphology of the underlying strata (i.e. till or bedrock), taking cognisance of further targeted ground investigation. It is recommended that an appropriately qualified geotechnical engineer, with experience in wind farm developments, be appointed as a supervisor on site to provide advice during setting out and construction works.

5.3 Mitigation Measures

If medium to high peat slide risk is confirmed during detailed pre-construction site investigation, mitigation measures should be implemented by VEWF and the appointed infrastructure contractor. These mitigation measures should be similar to the following:

- adequate training for staff to raise awareness of the risks and tell-tale signs of peat slides to site staff;
- development of an emergency plan and procedures in the event of a slide;
- develop methodologies to ensure that accelerated degradation and erosion of exposed peat deposits does not occur, and
- regular monitoring (e.g. regular visual and survey observations, and instrumentation).

Measures selected will be based on what is most appropriate to the specific ground conditions at each location.

5.4 Geotechnical Risk Register

A Geotechnical Risk Register will be compiled to include risks relating to peat instability in order to identify risks that may arise during construction. The hazards identified should be set out in the Geotechnical Risk Register, which is a live document and will be updated regularly.

6. Conclusions and Recommendations

6.1 Conclusions

A desk study has been undertaken for the proposed development and has incorporated a review of the published historical, geological information and relevant background literature available for the site. Site reconnaissance and site investigation was undertaken to supplement the desk study and enable a hazard and risk assessment for peat instability to be conducted. The information provided within this report has made reference to published guidelines[04/05] to provide an assessment of significant potential effects based on available data.

Peat probing investigations were planned and directed by VEWF to provide the information about the site. The site investigation and desk study records allowed an initial susceptibility scoring system to be developed. The pseudo-quantitative scoring system follows the general procedure laid down in the PLHRA guidelines on peat slide hazard assessment.

In its current condition, with no external influences, it is anticipated that construction of the track on the proposed alignment is likely to exacerbate the peat instability and could result in peat failure. The majority of the track, between chainage 0m to 2000m falls within medium to high risk of peat slide susceptibility with a section of very high risk between chainage 900m to 1000m. Given the proximity of the track to the B9075, the Burn of Weisdale, the Burn of Droswall and the existing track, the exposure rating in these areas is correspondingly high. This scoring can be assessed in more detail during subsequent stages of design development and following more detailed investigation and analysis.

To mitigate the potential effects of a peat slide, consideration should be given to the preventative measures and best practice design and construction practices provided in Section 5. A continual process of review/monitoring with assessment should also be put in place during construction to monitor any local variations and ensure that construction practices take full cognisance of any residual risks. This should be supplemented with training for construction and operations staff to identify the risks and consequences of works within areas of potential peat slides. It is considered that through additional investigation, analysis and the implementation of preventative measures, the risk and potential impact of peat slides can be adequately controlled.

Under the management of VEWF, an experienced engineer should be appointed to complete a detailed geotechnical design for particular sections of the access track deemed to be at higher risk of peat slide during construction. This will be based on location – specific mechanical characteristics of the peat deposits and morphology of the underlying strata (i.e. till or bedrock). Further targeted ground investigation will therefore inform the development of the more precisely detailed design using specific geotechnical data.

6.2 Recommendations for Further Work

This initial peat stability analysis was based on the available site investigation and desk study data, which has formed a pseudo-quantitative susceptibility assessment that should be developed and improved with supporting information. Supporting data required to further develop the PLHRA shall comprise the following:

- additional peat core sampling and testing along the new alignment to investigate the Acrotelm and Catotelm layers;
- additional peat investigation upslope and beyond the track corridor and detailed aerial photography;
- ground investigation of the bedrock and superficial deposits to determine the peat interface condition. This will also enable the assessment of:
    - rock excavatability;
    - slope stability within the sub-peat strata including rock condition;
    - groundwater regime for drainage purposes and hydrogeological model of underdrainage of peat; and
- full site reconnaissance to cover the re-alignment of the track.

On completion of the updated PLHRA and notwithstanding the discussed construction methodologies and mitigation measures, the following recommendations relating to the proposed construction elements, should be implemented by VEWFand the appointed Engineer:

- prepare method statements for mitigation measures including the use of check dams to limit flow and prevent contamination of watercourses;
- appoint a qualified and experienced engineering geologist or geotechnical engineer to advise during the setting out, micro-siting and construction phases of the works; and
- separate peat stability assessments should be undertaken for the sub-station and compound areas.

7. References

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Appendix A. Figures

Figure A1: Peat Susceptibility Scores- Surface Slope Angle

Figure A2: Peat Susceptibility Scores- Peat Thickness

Figure A3: Peat Susceptibility Scores- Sub-Stratum and Peat Interface

Figure A4: Peat Susceptibility Scores- Peat Strength

Figure A5: Peat Susceptibility Scores- Hydrology

Figure A6: Peat Susceptibility Scores- Evidence of Peat Instability

Figure A7: Peat Susceptibility Scores- Rainfall and Climate

Figure A8: Peat Susceptibility Scores- Peat Slide Susceptibility Rank

Figure A9: Peat Susceptibility Scores- Exposure

Figure A10: Peat Susceptibility Scores- Overall Peat Slide Ranking

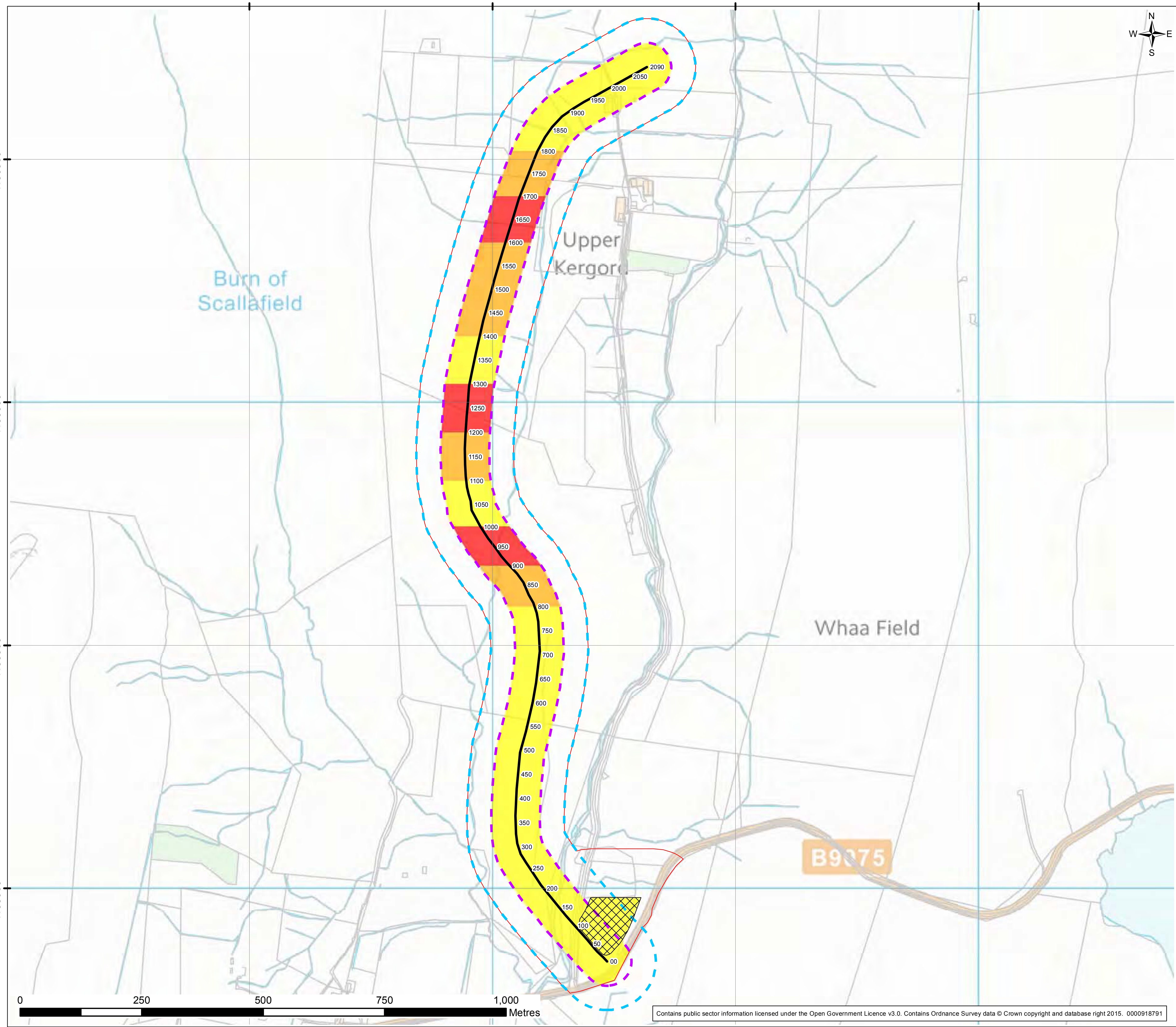

FIGURE A1

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 100m Buffer Zone
- 50m Buffer Zone

Surface Slope Angle	Score
Slope <5°	1.0
5° ≤ Slope < 10°	2.0
10° ≤ Slope < 15°	2.5
Slope ≥ 15°	3.0

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the susceptibility zones are approximate.

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PEAT SUSCEPTIBILITY SCORES - SURFACE SLOPE ANGLE

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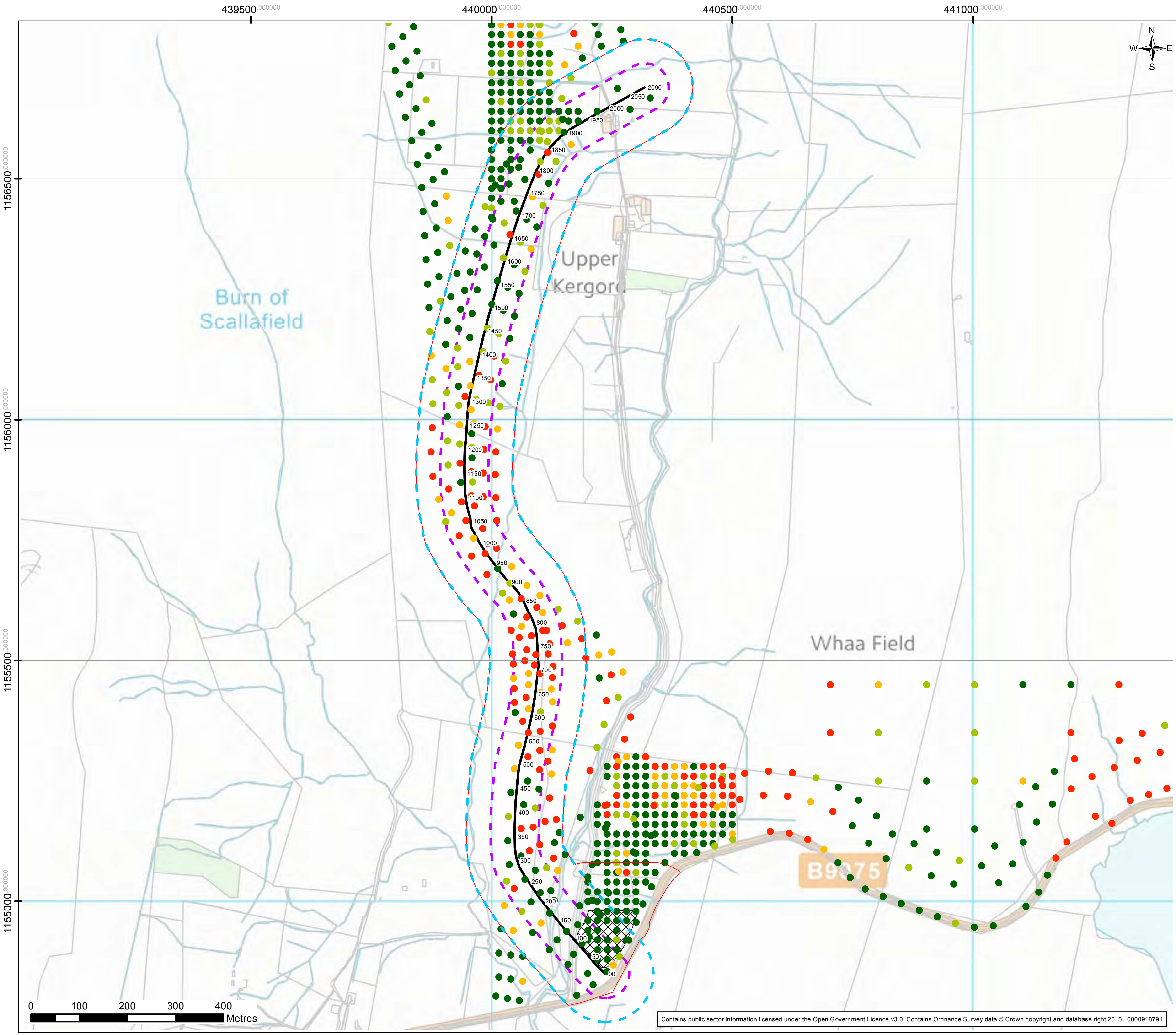
Scale @ A3	1:7,500	DO NOT SCALE
Jacobs No.	B1486007	

FIGURE A2



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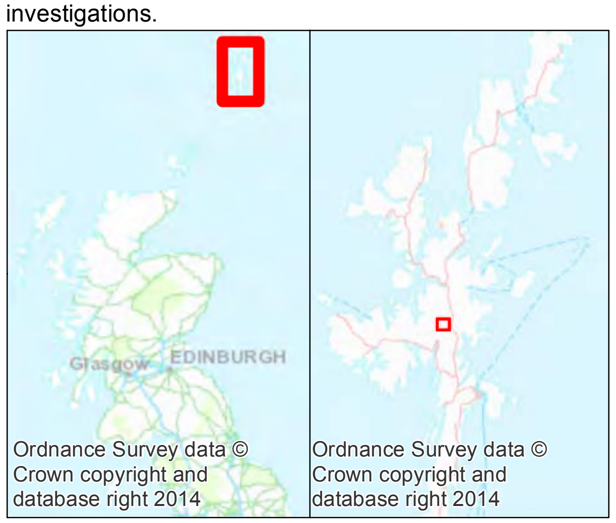
Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 100m Buffer Zone
- 50m Buffer Zone

Indicative Peat Thickness Range	Score
Peat < 1.0m	1.0
1.0m ≤ Peat < 1.5m	2.0
1.5m ≤ Peat < 2.0m	2.5
Peat ≥ 2.0m	3.0

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The peat thickness data is derived from the Raeburn Drilling Limited, September 2013 ground investigation and the RPS Group November 2015 and the April 2016 ground investigations.



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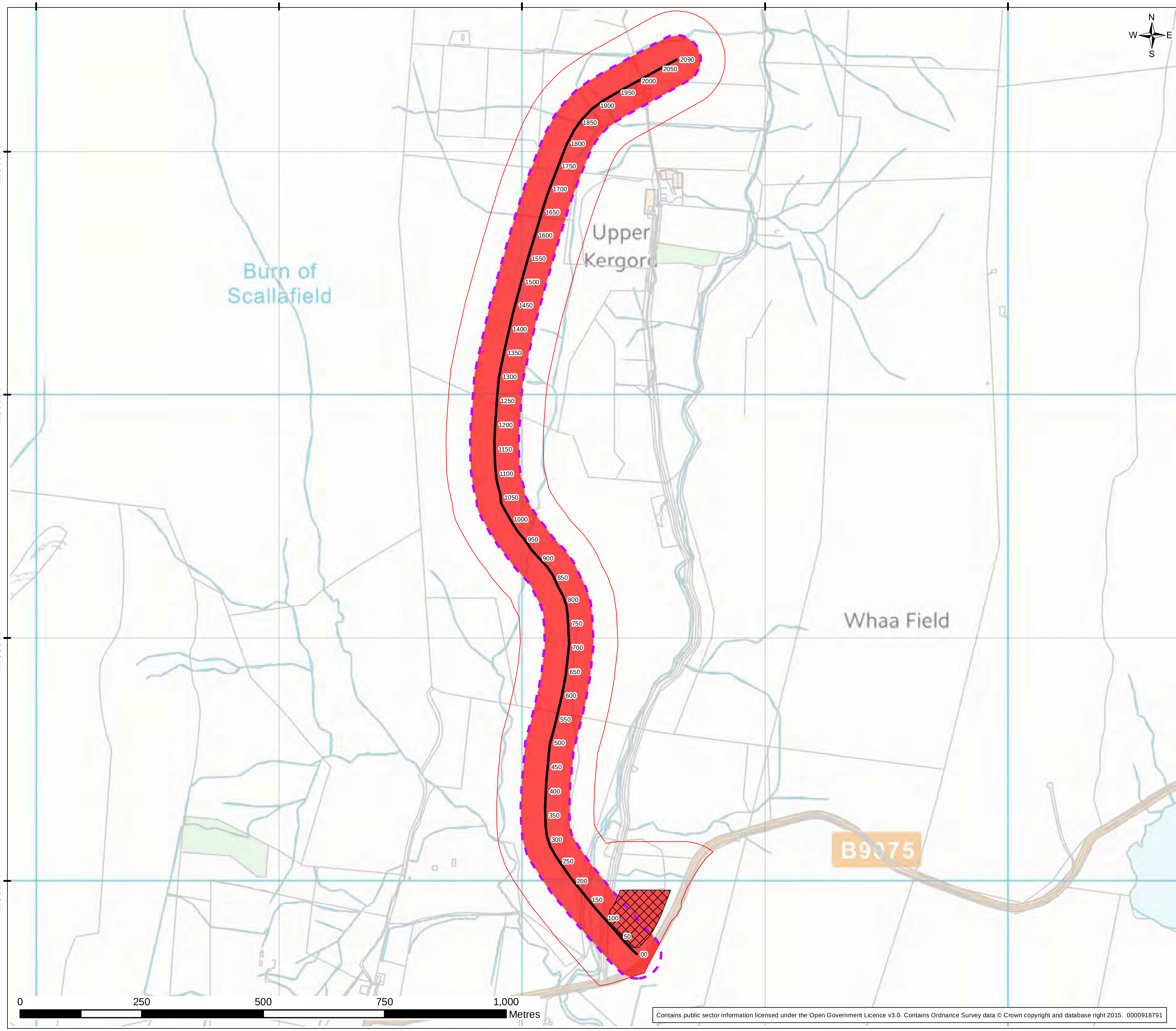


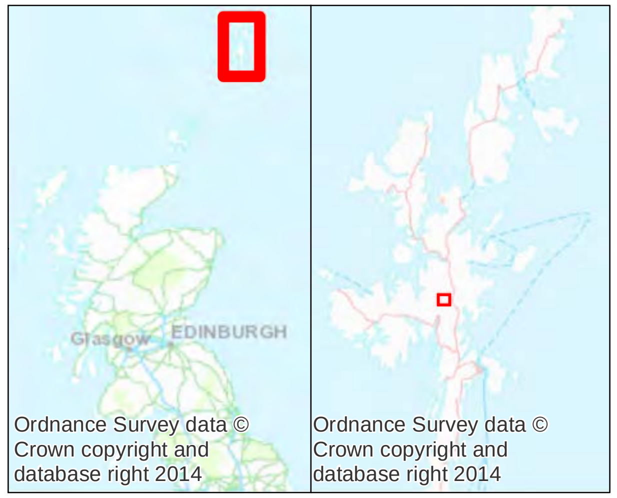
FIGURE A3

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Sub-Stratum and Peat Interface	Score
Rough Rockhead or Granular Subsoil	1.0
Undulating Rockhead or Granular Subsoil	1.5
Planar Rockhead or Cohesive Subsoil	2.0
Smooth Rockhead or Cohesive Subsoil	2.5

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the susceptibility zones are approximate.
3. The scores are default values, which have been adopted in the absence of factual information to the contrary.



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PEAT SUSCEPTIBILITY SCORES - SUB-STRATUM AND PEAT INTERFACE

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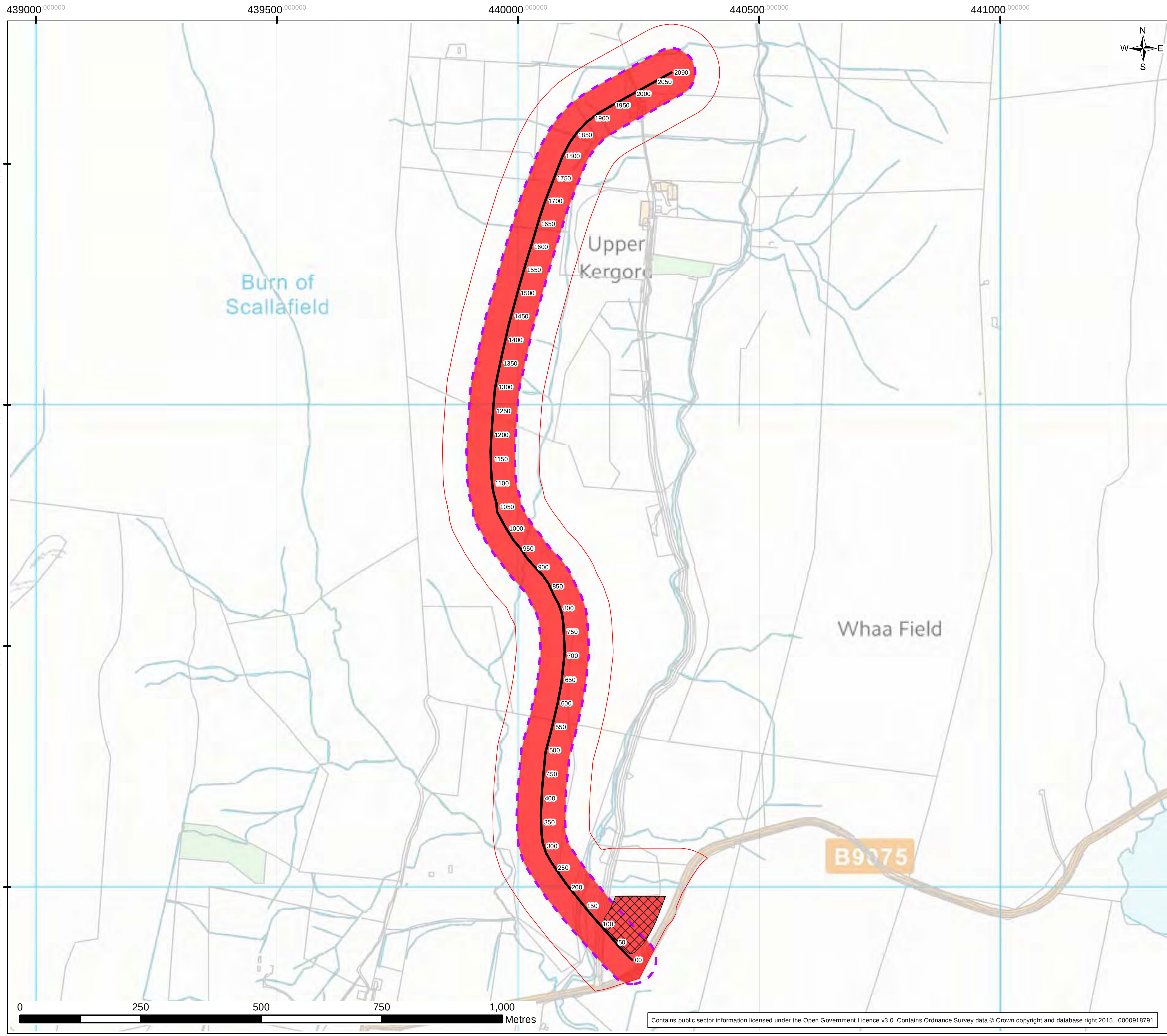

FIGURE A4

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Peat Strength	Score
Shear Vane 40kPa	1.0
Shear Vane 30kPa	1.5
Shear Vane 20kPa	2.0
Shear Vane 10kPa	2.5

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the susceptibility zones are approximate.
3. The score(s) shown are default values, which have been adopted in the absence of factual information to the contrary.

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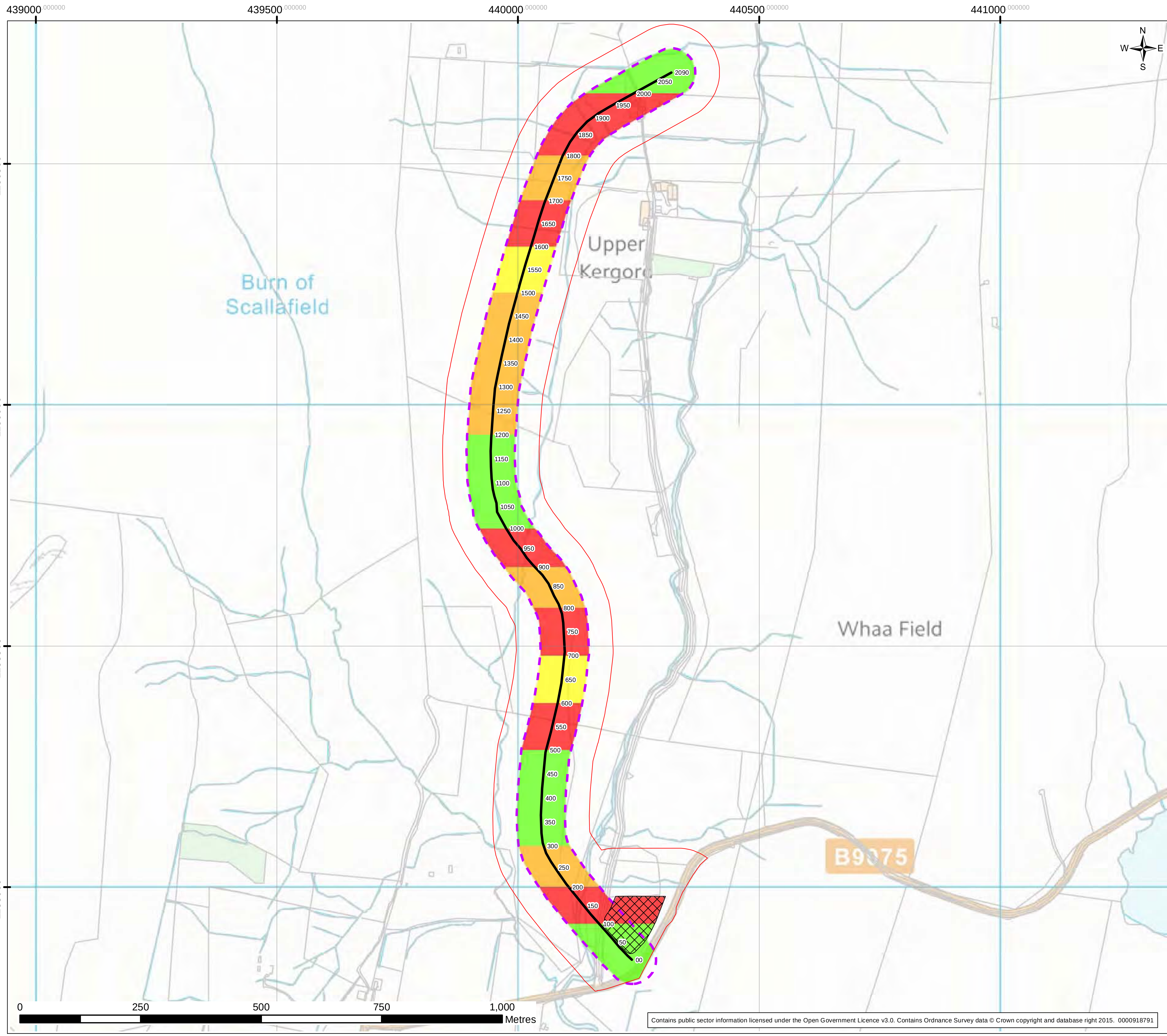


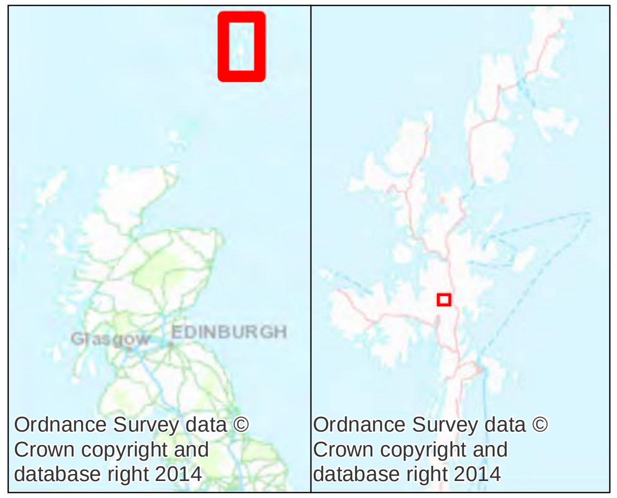
FIGURE A5

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Hydrology	Score
None Evident	1.0
Occassional	1.5
Frequent	2.0
Many	2.5

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the susceptibility zones are approximate.



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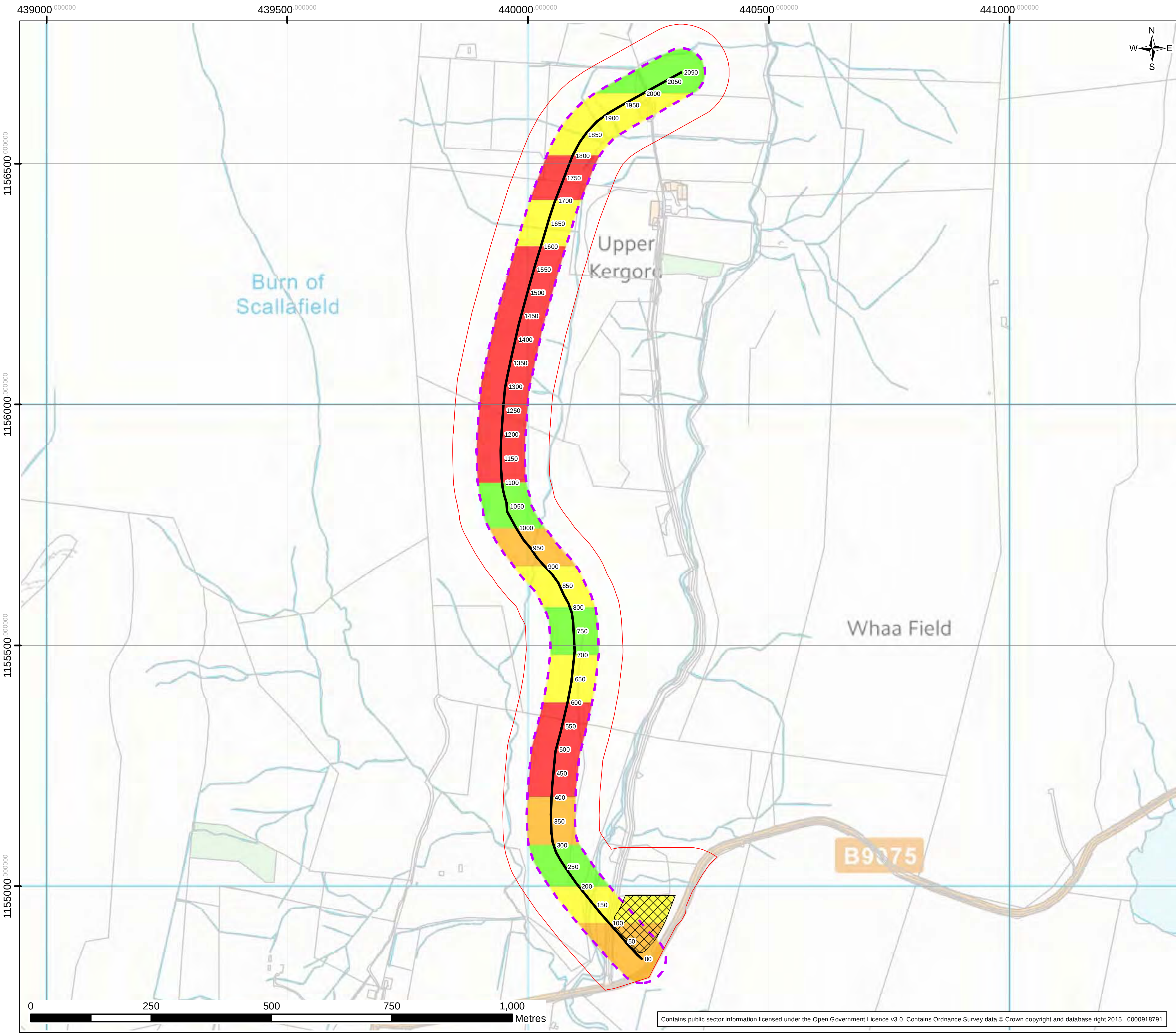


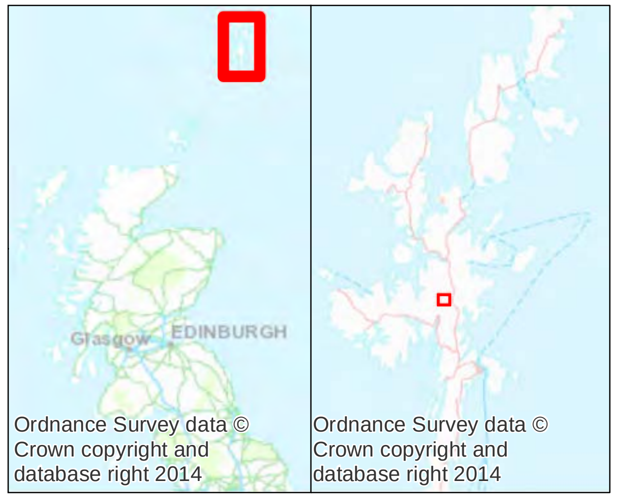
FIGURE A6

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Evidence of Peat Instability	Score
None Evident	1.0
Occassional	1.5
Frequent	2.0
Many	2.5

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the susceptibility zones are approximate.



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KERGORD ACCESS TRACK

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PEAT SUSCEPTIBILITY SCORES - EVIDENCE OF PEAT INSTABILITY

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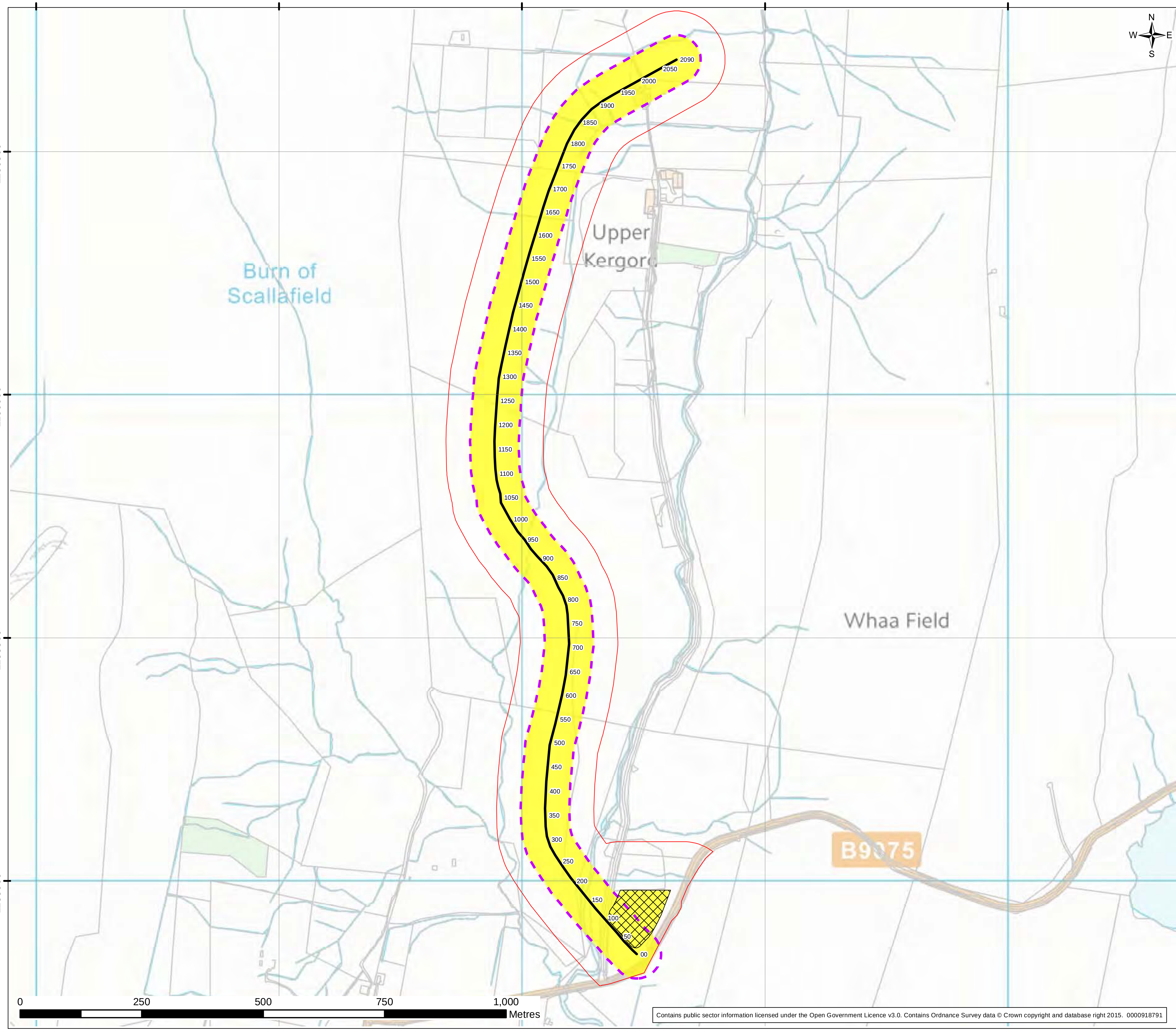

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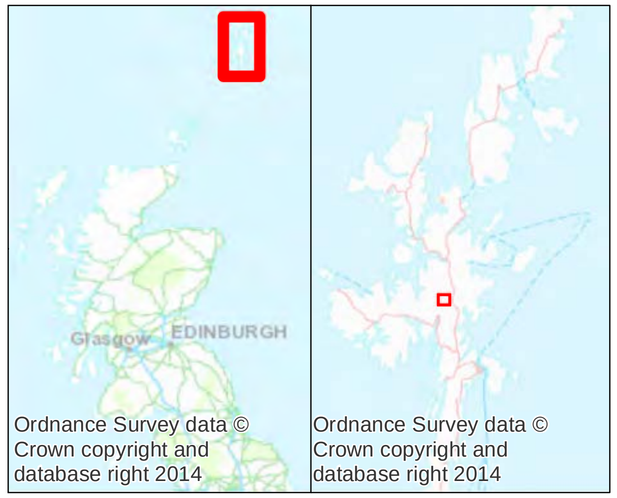
FIGURE A7

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Rainfall and Climate	**Score**
Low to Moderate Precipitation	1.0
Moderate Precipitation	1.5
High Precipitation	2.0
Very High Precipitation	2.5

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the susceptibility zones are approximate.



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Drawing Title

PEAT SUSCEPTIBILITY SCORES - RAINFALL AND CLIMATE

INITIAL ISSUE

Scale @ A3	1:7,500	DO NOT SCALE
Jacobs No.	B1486007	

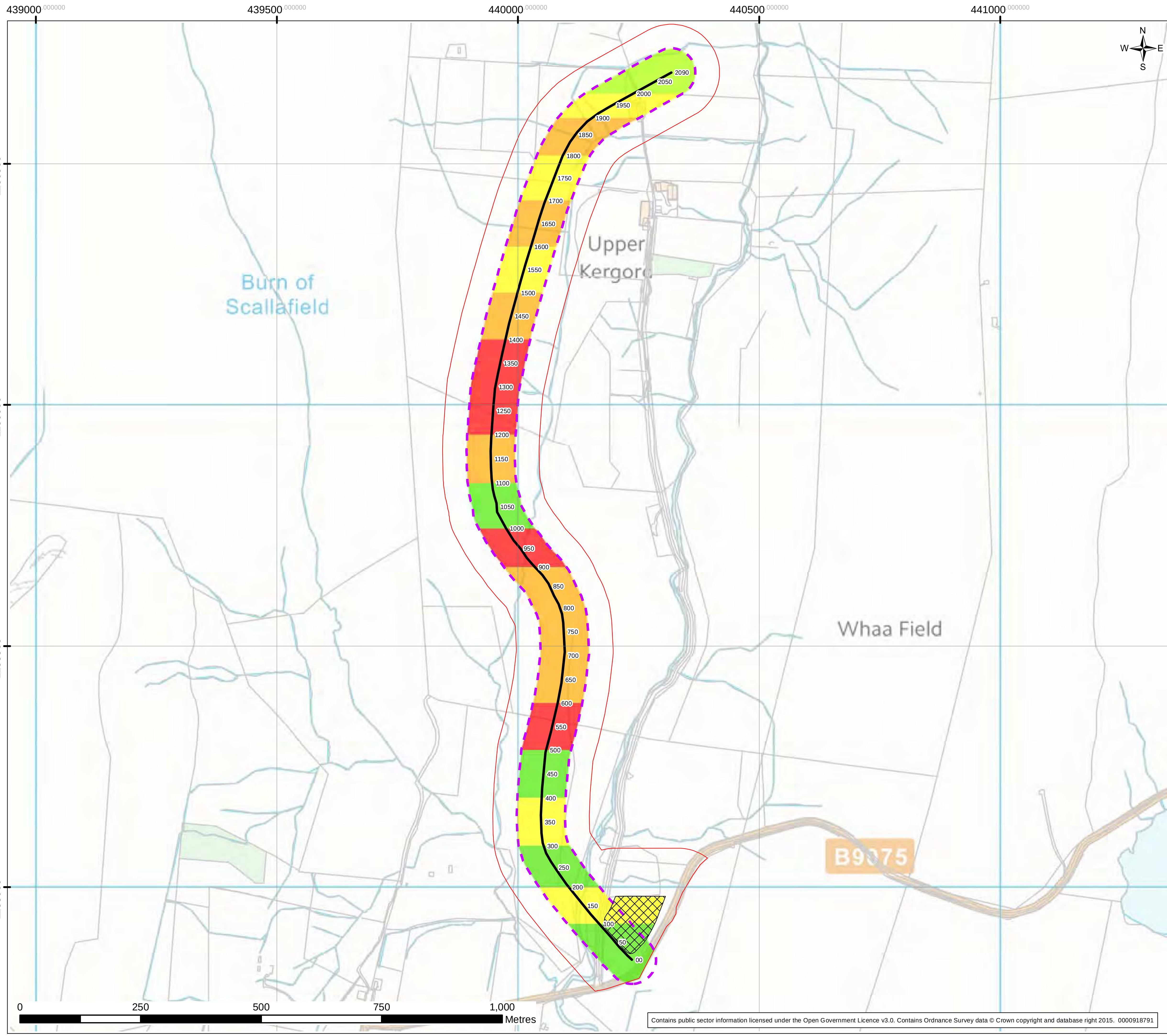

FIGURE A8

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Susceptibility Rank	Score
Very Low	0 to 30
Low	30 to 60
Medium	60 to 120
High	120 to 240
Very High	>240

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the susceptibility rank zones are approximate.

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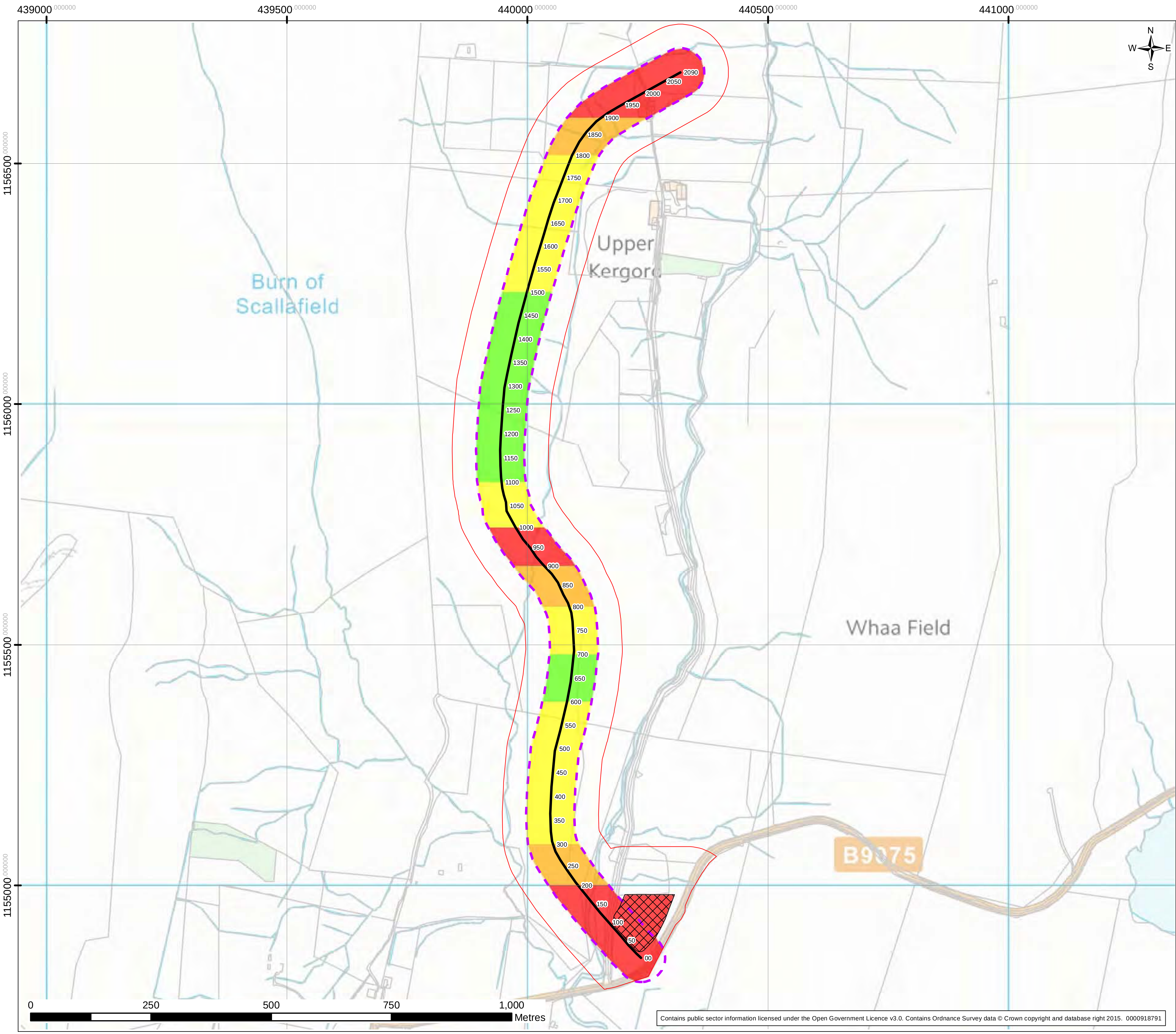
FIGURE A9



Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Exposure Rank	Score
Negligible Impact	1
Low Impact	2
Medium Impact	3
High Impact	4
Extremely High Impact	5

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard AND Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the exposure rank zones are approximate.

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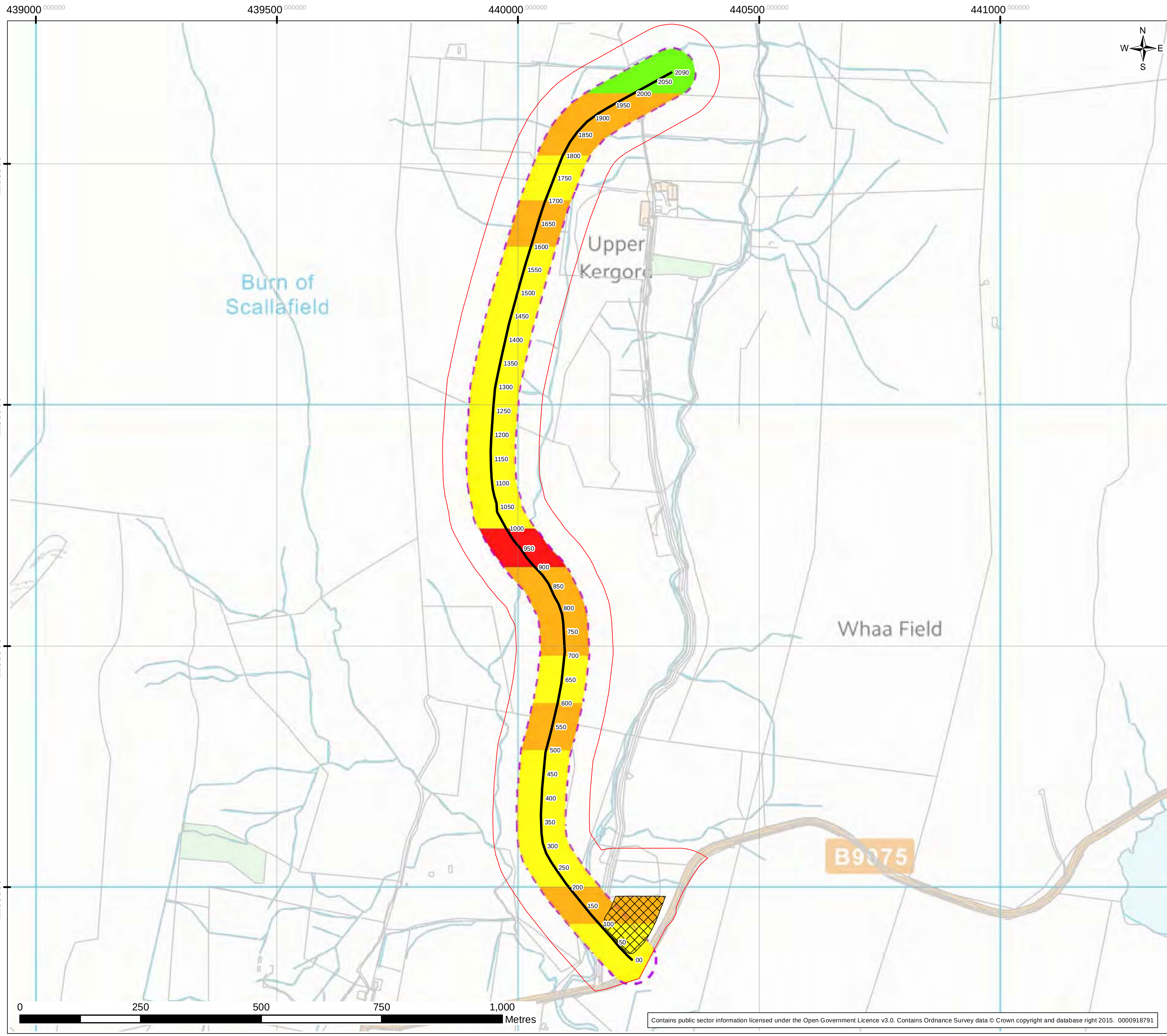

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FIGURE A10

Legend

- Site Boundary
- Proposed Development
- Proposed Construction Compound
- Chainage along the Proposed Development
- 50m Buffer Zone

Overall Peat Slide Rank	**Combined hazard and exposure score**
Very Low	0 to 1
Low	2 to 5
Medium	6 to 10
High	11 to 20
Very High	21 to 25

NOTES:
1. Refer to Kergord Access Track, Peat Landslide Hazard and Risk Assessment, B1486007/KAT/PLHRA
2. The extent of the overall peat slide rank zones are approximate.

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Drawing Title
OVERALL PEAT SLIDE RANKING

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Scale @ A3	1:7,500	DO NOT SCALE
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Appendix B. Site Reconnaissance

The following documents are available on request:

- Site Photos (No.01 - 26), Notes and Co-ordinates;
- Potential Hazard List Table;
- Figure B1 – Site Reconnaissance Photo Reference Plan; and
- Figure B2 – Site Reconnaissance General Hazard Location Plan.

Appendix C. Peat Probe Data

The following documents are available on request:

- Peat Probe Data from the 2013 Investigation by Raeburn Drilling;
- Peat Probe Data from the 2015 Investigation by RPS Group; and
- Peat Probe Data from the 2016 Investigation by RPS Group.

Appendix D. Peat Core Logs

The following documents are available on request:

- Peat Core Logs (B101 to Bw244) from the 2013 Investigation by Raeburn Drilling.

Appendix E. Drawings

The following documents are available on request:

- Peat Probing Drawings 1-3, RPS Group Ltd, Viking Wind Farm, Shetland, Kergord Peat Probing, Ground Investigation, Scale 1:2,500, 27th October 2015;
- Peat Probing Drawing, SSE Renewables Developments (UK) Ltd, Scale 1:8,000, 5th September 2013;
- Typical Sections, Standard Details, Shetland Islands Council, R/X/-01 Rev B, August 1989;
- Typical Sections, Standard Details, Shetland Islands Council, R/X/-02 Rev B, August 1989;
- Draft CAD drawing 'ACAD-Kergord 0.5m Intervals with Peat Depths', showing the track alignment, cutting and embankment slopes and track chainage received 08/04/16;
- Figure E1 – Kergord Access Track, Aerial Photography, Jacobs, 2016; and
- Figure E2 – Kergord Access Track, Site Plan, Jacobs, 2016.
- Figure E3 – Kergord Access Track, Ground Investigation - Combined Location Plan