Phase 1 Habitat Survey, National Vegetation Classification Survey and Groundwater Dependant Terrestrial Ecosystem Report for Beaw Field Wind Farm

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Annex 11.2.1 Groundwater Dependent Terrestrial Ecosystems (GWDTE) Risk Assessment

Summary

A proposal for a wind farm development has been made by the Applicant for Beaw Field Wind Farm, in Yell, Shetland. As part of this proposal, Alba Ecology Ltd. was commissioned to survey and map the habitats and plant communities within the Application Boundary plus appropriate buffer zones (the 'Study Area').

Field survey work was undertaken in May 2012, with two smaller, additional areas to the east and south undertaken in September 2015. Field work included an extended Phase 1 Habitat survey, a National Vegetation Classification (NVC) survey and an assessment of wetland habitats. Habitats and community types were described and mapped, a species list was compiled and target notes were made. From this, groundwater dependent terrestrial ecosystems (GWDTEs) were assessed and are reported on.

The Study Area was primarily described as dry modified blanket bog (39%) with large areas of wet modified bog (25%) and some unmodified blanket bog (8%). There were smaller areas of unimproved acid grassland (7%), dry dwarf shrub heath (4%) and improved grassland (2%) There were many mosaics of habitat types.

Introduction

Alba Ecology Ltd. was commissioned by the Applicant to conduct an extended Phase 1 Habitat survey and National Vegetation Classification (NVC) survey and to report on groundwater dependant terrestrial ecosystems (GWDTE) at Beaw Field Wind Farm as part of the Environmental Statement.

The Beaw Field Wind Farm Application Boundary is centred at the Burn of Hamnavoe at OS grid references HU 50461 82092, in the south of Yell. The Study Area for the Phase 1 Habitat survey, NVC survey and GWDTE survey included the Application Boundary plus a 300m buffer zone. The total size of the Study Area was 16.3km^2. A location map can be seen in **ES Volume 2: Figure 11.1** with the Study Area indicated with a red outline.

The Study Area was dominated by three ridges, the largest of which was the Hill of Arisdale at 210m above sea level. There were two valleys, Canis Dale and Aris Dale, which included the main streams running through them (Burn of Hamnavoe and Burn of Sundrabister respectively). There were several lochs and lochans in the south and east of the Study Area, the largest being Loch of Kettlester. Much of the Study Area had deep peat (for more details refer to **Chapter 12: Soils and Peat**) which had historic and current drainage, peat cutting and grazing.

This document reports the findings of the Phase 1 Habitat survey, NVC survey and GWDTE assessment undertaken by Alba Ecology Ltd. in May 2012 and September 2015.

Aims and Objectives

The objectives for this survey and report were:

- To identify, map and describe Phase 1 Habitats and NVC communities in the Study Area;
- To identify any particularly important habitats and species in the Study Area;
- To identify if wetland habitats in the Study Area are likely to be GWDTEs; and
- To evaluate the habitats identified, with an appraisal of implications for the proposed wind farm according to Ecological Impact Assessment Guidelines (IEEM, 2006).

Methods

The survey was conducted using 1:50,000 Ordnance Survey maps and aerial photographs with a resolution of 1m that were provided by the Applicant. The Phase 1 Survey was conducted at a Scale of 1:10,000 and the NVC survey was conducted at a scale of 1:7,500 using the Ordnance Survey maps and aerial photographs.

Habitat Surveys

Two survey methodologies were used to survey the vegetation: the Phase 1 Habitat survey (JNCC, 1990; Revised 2003) and the National Vegetation Classification (NVC; Rodwell, 2006). Phase 1 Habitat surveys are a standard national classification scheme of broad habitat types and are based on plant species presence and some abiotic indicators such as peat depth. The NVC is a more detailed survey of plant communities using plant species abundance as well as presence and often using quadrat data. More than one NVC community may be present in a single Phase 1 Habitat category. Groundwater dependant terrestrial ecosystems (GWDTE) were determined from the NVC survey results and from the Functional Wetland Typology (SNIFFER, 2009a). The Functional Wetland Typology was designed to enable a basic identification of wetland habitats in Scotland and Northern Ireland using landscape features, field indicators and by comparing NVC communities with a published table to assess the likelihood of groundwater dependency (SEPA, 2014).

Phase 1 Habitat Survey

A Phase 1 Habitat survey was conducted in May 2012 by Kate Massey and Donald Shields of Alba Ecology Ltd. with two smaller additional areas surveyed by Donald Shields and Robert Potter of Alba Ecology Ltd. in September 2015. The vegetation was described and mapped following the methods described in Joint Nature Conservation Committee (JNCC) Handbook for Phase 1 Habitat surveys (JNCC, 1990; Revised 2003) and IEEM best practice guidelines (O'Reilly, 2010).

The entire Study Area was walked at a slow pace to accurately map all the habitats present. The higher areas were used as vantage points to get views across the Study Area and map boundaries within the surrounding area. The habitat types were then 'ground truthed' by walking over the viewed areas and assigning or verifying habitat types. This was in accordance with Phase 1 procedures for hilly terrain (JNCC, 1990; revised 2003). Plant species were identified and habitat types assigned and mapped in the field. Where peat depth was an indicator of habitat type, apparent peat depth was judged by visual clues only (e.g. from haggs and ditches) and by pushing a walking pole into the peat to judge if it was ±0.5m. This was a very rough indication and does not constitute a formal peat survey (which is provided in **Chapter 12: Soils and Peat**). Peat depth as discussed in this report is estimated based on these visual assessments made during botanical field surveys only.

The Phase 1 Habitat survey was extended to include plant species lists for each habitat type and an assessment of each species overall abundance using the DAFOR scale (Dominant, Abundant, Frequent, Occasional and Rare). The smallest habitat size that was mapped was 50m^2. Where features were smaller than this, target notes were made and located with 10 figure grid reference readings using a hand-held Garmin geographical positioning system (GPS).

National Vegetation Classification (NVC) Survey

An NVC field survey was carried out in May 2012 by Kate Massey and Donald Shields of Alba Ecology Ltd. with two smaller additional areas surveyed by Donald Shields and Robert Potter of Alba Ecology Ltd. in September 2015. The vegetation was described and mapped in accordance with published standard NVC methodology (Rodwell, 2006).

NVC survey methods were not employed where the Phase 1 Habitat survey had identified dry or wet modified bog. This was because modified bog is a highly modified habitat type.

The NVC Study Area was walked at a slow pace, ensuring comprehensive coverage to accurately describe and map all communities. The higher areas were used as vantage points to aid mapping boundaries of the surrounding area. Where this technique was used the community types were 'ground truthed' by walking over the viewed area and assigning or verifying community types.

Each NVC community and sub-community type was assigned in the field by an experienced surveyor with the use of NVC field guides (Hall *et al.*, 2004; Elkington *et al.*, 2001; Cooper, 1997) and subsequently through comparisons with the published NVC communities using the definitions and the floristic tables (Rodwell, 1991; Rodwell, 1992; Rodwell, 1995, Averis *et al.*, 2004).

Quadrat data were only taken where, in the surveyor's professional judgment, the vegetation did not obviously fall into an existing published NVC community, or combination of communities. Standard NVC methodology does not require five, or indeed any, quadrats to be taken in each stand of vegetation (Rodwell, 2006). Where quadrat data was taken, the quadrats were 2x2m in size. All higher plants and common mosses were identified and their percentage cover assessed. The data was tabulated into consistency tables and compared to the published NVC communities using the keys and the floristic tables (Rodwell, 1991; Rodwell, 1992; Rodwell, 1995). In addition, TABLEFIT (Hill, 1996; Hill, 2011), a computer program which was developed specifically for this purpose, was used for comparison. TABLEFIT calculates the top five community types that the data fits and provides a co-efficient of best-fit. The NVC community was then judged by comparing the results of these two approaches and using the author's professional experience and judgment.

The minimum size of vegetation mapped was $20m^2$. Smaller stands were described as target notes, located with 10-digit grid reference readings using a GPS. Target notes were also made of any unusual features, rare species, management activities or other points of particular interest.

Groundwater Dependant Terrestrial Ecosystems

Wetland habitats were identified using the Functional Wetland Typology (SNIFFER, 2009a and 2009b). SNIFFER (2009a) cross-mapped the wetland typology with Phase 1 Habitats

and NVC vegetation types to allow comparison with existing survey data. Therefore, the Phase 1 and NVC communities that were already assigned were used to determine wetlands. An assessment was conducted by surveyors in May 2012 and September 2015 to assess the landscape settings of the communities and whether they conformed to the wetland habitat categories and to the groundwater dependency as described in the SNIFFER field survey manual (SNIFFER, 2009b).

Where wetlands were identified, an assessment was made as to whether they were likely to be GWDTEs as defined by Table 2 in SEPA Guidance Note LUPS-GU4 Version 7 (SEPA, 2014).

Nomenclature

Both common and binomial scientific names are given the first time a species is mentioned within this report. Thereafter, common names only are used. Nomenclature follows Streeter (2009) for higher plant species, and Atherton *et al*. (2010) for bryophyte species. Plant groups comprising many micro species (such as dandelions *Taraxacum*) are treated as aggregates. These micro species are not important for defining Phase 1 Habitat or NVC communities.

Habitat and Species Evaluation

The UK Biodiversity Action Plan (BAP) was published in 1994, and was the UK Government's response to the Convention on Biological Diversity (CBD), which the UK signed up to in 1992 in Rio de Janeiro. Action plans for the most threatened species (so called UK BAP species) and habitats were set out to aid recovery. Since the middle of 2012, the UK Government has changed its strategic thinking following the publication of the CBD's '*Strategic Plan for Biodiversity 2011–2020*' and its 20 '*Aichi targets*', at Nagoya, Japan in October 2010, and the launch of the new EU Biodiversity Strategy in May 2011 (JNCC, 2015). The implications of this in Scotland are not yet clear, since most current planning policy and SNH guidance requires consideration of UK BAP priorities. To comply with existing planning policy and guidance this report continues to identify the UK BAP priorities.

There are Local Biodiversity Action Plans (LBAPs) that are relevant to local areas and are implemented by local authorities and interest groups (JNCC, 2015). The LBAP that covers the Study Area is the Shetland Local Biodiversity Action Plan (Taylor, 2004).

The Wildlife and Countryside Act 1981 (as amended) consolidates the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) and Council Directive 79/409/EEC on the conservation of wild birds (Birds Directive) in Great Britain (N.B. *Council Directive 79/409/EEC* has now been replaced by *Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds (codified version)*). The Act provides a list of legally protected species and a mechanism for the notification and confirmation of SSSIs. These SSSIs are identified for

their flora, fauna, geological or physiographical features by Scottish Natural Heritage (SNH) under *The Nature Conservation (Scotland) Act 2004*.

Habitats, higher plant and bryophyte species recorded during this survey were evaluated for conservation status including UK BAP and LBAP priority habitat and species definitions (Maddock, 2008).

Habitat categories and the 'condition' of these categories are human (or artificial) constructs and therefore subjective and a matter of professional judgement. Furthermore, different conditions can co-exist in an area of habitat (e.g. through drainage, preferential grazing, peat cutting, trampling etc.) and so it is not appropriate to assume an entire area of habitat is in one condition or another. Under these circumstances it is usually reported that the habitat is approaching a particular condition. This is fully recognised in Phase 1 Habitat and NVC assessments and consequently it is not always possible to be unequivocal when making judgements such as whether a particular habitat is classified under one condition or another. Where discrepancies have occurred with vegetation communities, they have been noted and explained.

Limitations

Standard sampling methods were followed, and any biases or limitations associated with these methods could potentially affect the results collected. Furthermore, while every effort was made to provide a full assessment and comprehensive description of the Study Area, it is unlikely that one survey can achieve full characterisation of a site due to variations that occur with time.

The Phase 1 Habitat, NVC and GWDTE maps are only indicative of the habitat boundaries of the Study Area. It was difficult to map the area to a high degree of accuracy because there was usually no clear boundary between vegetation types, there being instead a gradual gradation. Also, many of the NVC communities in the Study Area contained a similar assemblage of species, and were often at a transitional stage between two community types. This is a recognised limitation of all vegetation mapping. Surveying in Scotland and particularly Shetland has the added limitation that the NVC community descriptions were mostly derived in England. Therefore, the fit of the communities to the published communities are often imperfect and the closest approximation of the communities is described.

Estimating peat depth can be an important component for determining some Phase 1 Habitat types and Functional Wetland Typology types. However, it is important to note that measuring peat depth was outside the scope of these surveys. Apparent peat depth as discussed in this report is estimated based on visual assessments only.

Results

The Phase 1 Habitat survey map is shown in **ES Volume 2: Figure 11.3** and a list of habitat types are displayed in Table 1. The NVC survey map is shown in **ES Volume 2: Figures 11.4** with the GWDTE map in **ES Volume 2: Figure 11.5**. These figures are supported with a species list (Table 3) and a list of target notes (Table 4). Photographs of the habitats and interesting features and species are shown in Photographs 1-9.

Overview

The Study Area was found to be primarily dry modified blanket bog (39%) with large areas of wet modified bog (25%) and some unmodified blanket bog (8%). There were small areas of unimproved acid grassland (7%) and improved grassland (2%) There were many mosaics of habitat types. Table 1 displays the full list of Phase 1 Habitats mapped and the total estimated area of each habitat type found within the Study Area.

Phase 1 Habitat	Area (km^2)	Area (ha)	Percentage cover (%)
Dry modified bog	6.321	632.1	38.9
Wet modified bog	4.006	400.6	24.6
Unmodified blanket bog	1.300	130.0	8.0
Unimproved acid grassland	1.162	116.2	7.1
Dry dwarf shrub heath	0.587	58.7	3.6
Unimproved acid grassland/bare peat	0.385	38.5	2.4
Dry modified bog/unimproved acid grassland	0.360	36.0	2.2
Improved grassland	0.342	34.2	2.1
Wet modified bog/dry modified bog	0.274	27.4	1.7
Semi-improved acid grassland	0.265	26.5	1.6
Dry modified bog/bare peat	0.226	22.6	1.4
Wet dwarf shrub heath	0.226	22.6	1.4
Open water	0.128	12.8	0.8
Dry modified bog/bare ground	0.126	12.6	0.8
Unmodified blanket bog/dry modified bog	0.111	11.1	0.7
Sea	0.071	7.1	0.4
Wet heath/unimproved acid grassland	0.065	6.5	0.4
Marshy grassland	0.043	4.3	0.3
Buildings and roads	0.034	3.4	0.2
Bare ground	0.033	3.3	0.2
Wet modified bog/acid grassland	0.033	3.3	0.2
Dry heath/unimproved acid grassland	0.027	2.7	0.2
Wet modified bog/wet heath	0.024	2.4	0.1
Improved grassland/unimproved acid grassland	0.024	2.4	0.1
Bare peat/bare ground	0.021	2.1	0.1
Unimproved calcareous grassland	0.021	2.1	0.1

Phase 1 Habitat	Area (km^2)	Area (ha)	Percentage cover (%)
Intertidal	0.019	1.9	0.1
Acid flush/unimproved acid grassland	0.018	1.8	0.1
Acid flush	0.009	0.9	0.1
Unmodified blanket bog/ wet modified bog	0.009	0.9	0.1
Semi-improved neutral grassland	0.001	0.1	0.0
Total	**16.269**	**1626.9**	**100**

***Table 1**: The area (km^2 and ha) and percentage cover of each Phase 1 Habitat found in the Study Area.*

Habitat and Community Descriptions

The habitat and communities that were found within the Study Area are described in the following manner: a Phase 1 Habitat description (**with a large bold title**), followed by the corresponding NVC community(ies) (***with a bold italic title***), followed by the relevant Functional Wetland Typology category (**with an underlined bold title**). There can be several Phase 1 habitats and NVC communities described in one Functional Wetland Typology Category.

Dry modified bog

Photograph 1: Dry modified bog formed extensive areas of uniform ling heather dominated vegetation.

Much of the Study Area (39%) was classified as dry modified bog. For Phase 1 Habitat survey purposes bog is defined as vegetation occurring on peat greater than 0.5m. To determine whether bog is unmodified or modified depends primarily on the amount of bog-mosses present. Whether the vegetation is wet modified or dry modified bog is determined by the amount of bog-mosses present and whether the vegetation resembles wet dwarf shrub heath or dry dwarf shrub heath. Within the Study Area, the dry modified bog had very little to no bog-mosses present and was characterised by dry dwarf shrub vegetation but on deep peat (often appearing to be greater than 2m deep). The vegetation was overwhelmingly dominated by ling heather (*Calluna vulgaris*). This habitat was common

across the Study Area which was likely to be an artefact of the heavy grazing and historic and current drainage and peat cutting.

The dry modified bog was often found on gentle to fairly steep hill slopes within the Study Area. There was occasionally some hagging and bare peat, but more regularly it was areas of continuous ling heather with hypnoid mosses below. Alongside the ling heather, there was abundant hair's-tail cottongrass (*Eriophorum vaginatum*) and common cottongrass (*Eriophorum angustifolium*) which could be patchy in their distribution. Occasionally common cottongrass could be co-dominant with the ling heather. Crowberry (*Empetrum nigra*) was frequently found growing through the ling heather as small, low mats and bell heather (*Erica cinerea*) was occasion. There were very few forbs present. The ground flora was dominated by either glittering wood moss (*Hylocomium splendens*) with frequent red-stemmed feather-moss (*Pleurozium schreberi*) or woolly fringe moss (*Racomitrium lanuginosum*) which could be extensive below the vascular plants. Lichens were common, particularly *Cladonia arbuscula*.

There were very rarely any bog-mosses present. Where they were present it was usually a very small, isolated patch of red bog-moss (*Sphagnum capillifolium*). The bog-mosses, where they did occur, were confined to the hollows and were often drying out.

There was no NVC community associated with this modified habitat, (although it most closely resembles a species poor H10a sub-community).

Wet modified bog

A total of ca. 25% of the Study Area was classified as wet modified bog. The peat depth appeared greater than 0.5m although much of the wet modified bog was characterised by extensive hagging which resulted in exposed rock at the bottom of haggs in some areas. The wet modified bog did have a little bog-moss present, but this was very patchy in its extent. Red bog-moss was the only common bog-moss present with occasionally some remnant papillose bog-moss (*Sphagnum papillosum*). In its place, woolly fringe moss dominated over the peat, particularly over the drying haggs. The woolly fringe moss formed dense tussocks in some areas causing the landscape to look knobbly. Lichens were also a common feature of the ground flora, particularly *Cladonia arbuscula*, but also *Cladonia uncialis* sub sp *uncialis*.

The wet modified bog was species poor in vascular plants. They were dominated by short ling heather and common cottongrass. There were frequently small patches of deergrass (*Trichophorum cespitosum*) which was likely to increase in abundance later in the season. Crowberry was creeping through the ling heather, and there was very occasionally a small sprig of cross-leaved heath (*Erica tetralix*). Hare's-tail cottongrass was scarce in the wet modified bog. No forbs were recorded in the wet modified bog. In wetter patches and on bare peat, heath rush (*Juncus squarrosus*) could be abundant.

Photograph 2: Extensive hagging and bare peat were common features in the wet modified bog.

Peat haggs were sometimes a feature of the unmodified blanket bog and dry modified bog but were an important characteristic of the wet modified bog. The haggs ranged in depth from 0.5m to greater than 4m deep. The haggs were mainly bare peat, but they often had sparse colonisation of vegetation, usually less than 5% of the cover. Heath rush, common cottongrass and deergrass were the dominant colonising species.

There were several large patches of bare peat in the Study Area. The peat was usually deep, but had been exposed. On the bare peat there was usually less than 5% vegetation. Common cottongrass and heath rush were usually the only vascular plants colonising the bare peat. Bare peat was also mapped in areas where there had recently been peat cutting, particularly in the east of the Study Area.

There was no NVC community associated with this modified habitat, (although it most closely resembles the M17b sub-community).

Unmodified blanket bog

Unmodified blanket bog made up 8% of the Study Area. The unmodified blanket bog was on deep peat which always appeared deeper than 0.5m. The water table was usually at or near the ground surface making it a wet habitat. The bog-moss layer could be an almost complete carpet but much more often formed a network of patches with bare peat below the dwarf shrubs. However, in the unmodified blanket bog the bog-moss layer was closer to a carpet and thicker than in the modified bog habitats. In Phase 1 Habitat surveys bog-moss abundance is an indicator of whether bog was modified or unmodified (JNCC, 1990; Revised 2003). Where there was a higher degree of bog-mosses, with accompanying bog species such as hare's-tail cottongrass, the bog was classified as unmodified. Although a cautionary approach was used, so bog that was judged to be on the border between modified and unmodified was classified as unmodified blanket bog. The unmodified blanket bog was often found in shallow valleys where drainage was limited.

The vegetation was dominated by ling heather with hare's-tail cottongrass and common cottongrass often abundant in the vegetation. Round-leaved sundew (*Drosera rotundifolia*) was the only common forb in the unmodified blanket bog. Crowberry was frequently growing

below the ling heather, deergrass and stiff sedge (*Carex bigelowii*) were occasionally present in the vegetation.

Photograph 3: Pools were often a feature of the unmodified blanket bog habitat.

Pools were often a feature of the unmodified blanket bog habitat. The pools were generally shallow and quite small, approximately 2m^2. They often contained bog-moss, usually feathery bog-moss (*Sphagnum cuspidatum*) and there was often more papillose bog-moss or red bog-moss near the pools. The bog pools were found in hollows and soakaways within the blanket mire habitat. They were too small to map and some have been target noted.

Six NVC communities were described within the unmodified blanket bog classification.

M1 Sphagnum denticulatum bog pool community

These bog pools were found scattered across the site within areas of blanket bog and were too small to map. They were species-poor, consisting of little more than submerged carpets of cow-horn bog-moss (*Sphagnum denticulatum*), alongside smaller amounts of feathery bog-moss. The only common vascular species recorded were common cottongrass and bulbous rush (*Juncus bulbosus*).

M2a Sphagnum cuspidatum/fallax bog pool community Rhynchospora alba sub-community

The M2a bog pools were filled with bog-mosses and had few other species. Feathery bog-moss was the most common bog-moss in these pools but red bog-moss and papillose bog-moss were present usually to the edges of the pools. Common cottongrass was growing in the pools through the bog-mosses.

These pools were found in hollows and soakaways and seepage lines within the blanket mire communities. They were usually small, often only about 2m in diameter. Therefore, they were too small to map but some were target noted.

M3 Eriophorum angustifolium bog pool community

The M3 communities occurred on wet, often exposed peat that was being re-colonised by bog plants. It was found below and between haggs, on disturbed areas of exposed peat, drying exposed peat and as shallow pools. The M3 community consisted mainly of common cottongrass and heath rush colonising the peat. The common cottongrass was sometimes a thick sward, but more regularly was sparse with few additional species. There were also patches with a small amount of ling heather establishing. The bog-mosses that were in this community were sparse and, where present, were in small, thin patches. Red bog-moss was most frequently seen.

Several M3 bog pools were mapped. However, they were usually too small to map. They occurred frequently in bog communities.

M18 Erica Tetralix – Sphagnum papillosum blanket mire community

This blanket bog community was found in one small location in the east of the Study Area. It was in a flat location that had the water table at ground level. There were some M3 bog pools present which were not mapped due to their small size, but were target noted.

The M18 community had a thick carpet of bog-mosses which dominated the vegetation. Red bog-moss and papillose bog-moss were the most common bog-mosses, although feathery bog-moss was present at the edges and within the bog pools and soft bog-moss (*Sphagnum tenellum*) was also present a low abundance.

Above the moss layer there was a sparse vascular flora. Sparse ling heather was the most common species but there was also hare's-tail cottongrass and common cottongrass as well as crowberry and some carnation sedge, bog asphodel and round-leaved sundew.

M19 Calluna vulgaris – Eriophorum vaginatum blanket mire community

Most of the unmodified blanket bog in the Study Area was classified as the M19 community. This type of mire community is common in northern areas and tolerates drier peat than other NVC mire communities (Averis *et al.* 2004).

Photograph 4: The M19 blanket mire community was dominated by ling heather and hare's-tail cottongrass.

The M19 was dominated by ling heather with abundant hare's-tail cottongrass and common cottongrass. Crowberry was a frequent dwarf shrub growing as a mat below the ling heather. Deergrass was present in some stands of the vegetation but was not abundant.

Below the vascular plants, red bog-moss was prevalent. There was occasionally some papillose bog-moss. Lichens were very frequently present, particularly *Cladonia arbuscula*. They formed a distinctive silvery layer over the peat. Other mosses were also present, particularly glittering wood-moss and red-stemmed feather-moss.

The M19 community was often found on flat areas within the Study Area which appeared to be water logged. It usually had some M2 and M3 bog pools present with damp patches of feathery bog-moss.

M20 Eriophorum vaginatum blanket mire community

The M20 community was recorded in a single location in the south of the Study Area. It was located in a small, flat area in a on a slope. As well as being wet underfoot (with the water table at or just below ground level), there was a small bog pool present within this area that was considered too small to map. The majority of the M20 community was fenced and appeared to have lower grazing pressure than the majority of the Study Area.

The distinctive feature of the M20 community was the dominance of hare's-tail cottongrass with little to no ling heather. Other species recorded at low abundances included crowberry, common cottongrass, lichens, red bog-moss, papillose bog-moss and viviparous sheep's fescue (*Festuca vivipara*).

Peat bog

In the Functional Wetland Typology peat bog is defined as wet peat, which is generally thicker than 0.5m, with heather, cottongrasses and some small sedge species (SNIFFER, 2009b). The Phase 1 Habitats dry modified bog, wet modified bog and unmodified blanket bog fits into this peat bog category and the NVC communities M1, M2, M3, M18, M19 and M20 are within this Functional Wetland Typology category.

Wet dwarf shrub heath

In Phase 1 Habitat surveys, the classification of heath requires there to be greater than 25% cover of dwarf shrub and peat less than 0.5m deep or mineral soil (JNCC, 1990; Revised 2003). The wet heath habitat was dominated by ling heather, which made up more than 25% cover. Where the wet dwarf shrub heath had underlying peat, the peat was estimated to be less than 0.5m deep. This is a key determinant between wet dwarf shrub heath and blanket bog habitats and is a diagnostic feature where blanket bog and wet dwarf shrub heath vegetation are similar (JNCC, 1990; Revised 2003).

One wet heath NVC community was described.

M15 Trichophorum cespitosum – Erica tetralix wet dwarf shrub heath community

The M15 community was recorded on gentle to medium slopes in the south and east of the Study Area. Ling heather was the dominant species within this community. The vegetation similar to the more extensive areas of wet modified bog in its floristic make-up. However it had less cottongrasses and a higher proportion of deergrass. Although both common cottongrass and hare's-tail cottongrass had a low abundance, they were constant in the vegetation. In some areas, which appeared to have a history of peat cutting, there was often a lower coverage of ling heather and an increase in heath rush.

Where the M15 was found in the eastern part of the study area, the ground was dry and stony with the presence of heath rush, mat grass (*Nardus stricta*) and pleurocarpus mosses (little shaggy-moss (*Rhytidiadelphus loreus*), red-stemmed feather-moss and glittering wood-moss. This is indicative of the dry, grassy M15d. In the southern section, there were small patches of M15 located within the extensive area of H14 dry heath which were distinctly wetter, and these belonged to the M15b sub-community. These areas had species such as tormentil, bog asphodel (*Narthecium ossifragum*) and round-leaved sundew (*Drosera rotundifolia*) over a patchy carpet of bog-moss, most commonly red bog-moss and papillose bog-moss. The M15c sub-community also occurred in small, clearly-defined patches within this same extensive area of H14 heath, around the fringes of bare peat.

This community generally did not exhibit the sort of hagging that was often recorded in areas of wet modified bog and other communities within the Study Area.

Wet heath

Wet heath as defined by the Functional Wetland Typology is heather dominated vegetation on peat less than 0.5m in depth with the presence of bog-mosses and small sedges (SNIFFER, 2009b). This is similar to the Phase 1 Habitat wet dwarf shrub heath and the NVC community M15.

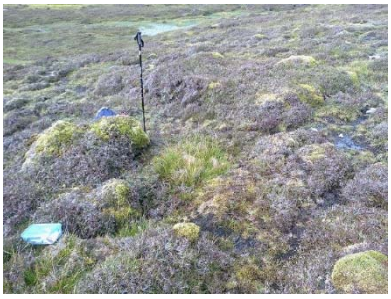
Dry dwarf shrub heath

The classification of heath in Phase 1 Habitat Surveys requires there to be greater than 25% cover of dwarf shrub and peat less than 0.5m deep or mineral soil (JNCC, 1990; Revised 2003). Within the Study Area, the dwarf shrub layer was dominated by ling heather and the peat was apparently less than 0.5m, often much less.

Two NVC communities was described with dry dwarf shrub heath.

H10b Calluna vulgaris – Erica cinerea heath, Racomitrium lanuginosum sub-community

H10b is a common upland heath community. It was similar to areas of dry modified bog. However, there was an increase in species associated with drier heaths such as bell heather. It was also differentiated from the dry modified bog as it was found on areas of shallow peat. The ground layer was dominated by woolly fringe moss though this was not always forming a continuous carpet.



Photograph 5: The ling heather and bell heather H10 heath community.

Ling heather was the dominant sub-shrub and was tall and erect which distinguished it from the H14 heath described below. Bell heather was frequently and constant in the vegetation. Mat grass and sheep's fescue (*Festuca ovina*) were the most common graminoid present. There was occasional common bent (*Agrostis capillaris*). Green-ribbed sedge (*Carex binervis*) was frequent, helping to define this community. Carnation sedge (*Carex panacea*) was also frequent and pill sedge (*Carex pilulifera*) was occasional. Forbs were represented by frequent tormentil (*Potentilla erecta*) and heath bedstraw (*Galium saxatile*), and rarely wild thyme (*Thymus polytrichus*). The most common moss was woolly fringe-moss which was frequent to abundant.

This community could be fairly hummocky in appearance where there was evidence of previous peat cutting.

H14 Calluna vulgaris – Racomitrium lanuginosum heath community

This community is a montane dry heath which is characterised by low-growing, prostrate ling heather with a dense carpet of woolly fringe moss (Averis *et al.* 2004). It was found on the summits of hills and in exposed locations where the soil was thin and rocky.

Photograph 6: The ling heather and woolly fringe moss H14 heath community.

Ling heather and woolly fringe moss were the dominant species in this community. The ling heather was prostrate and short, often less than 5cm tall, due to high winds pruning the heather. The woolly fringe moss was in a thick layer. Stiff sedge and crowberry were abundant and conspicuous. Small spings of bilberry (*Vaccinium myrtillus*) were often present and bell heather could be frequent with occasional heath rush. Mat grass was constant but had a low abundance. Velvet bent (*Agrostis canina*) and tormentil were occasional. Alpine bearberry (*Arctostaphylos alpinus*) was also found in the H14 community but was not constant. Lichens and glittering wood-moss could be frequent with the woolly fringe moss.

Where this community occurred adjacent to H10, the boundary between them was transitional. Woolly fringe-moss increased till it became co-dominant with ling heather and the ling heather became dwarfed and prostrate.

Dry heath communities are not considered to be wetland habitats in the Functional Wetland Typology.

Improved grassland

There were areas of improved grassland around the southern and eastern perimeter of the Study Area. These were enclosed ‘in-bye’ fields that were heavily grazed by sheep and/or cattle resulting in a short sward (2-5cm tall). The improved grassland was bright green compared to the surrounding vegetation and was dominated by perennial rye grass (*Lolium perenne*) with frequent or abundant white clover (*Trifolium repens*).

Photograph 7: Bright green improved grassland.

One NVC community was described:

MG7a Lolium perenne leys and related grasslands, Lolium perenne – Trifolium repens leys sub-community

Perennial rye grass dominated the MG7a grassland with abundant white clover, Yorkshire fog (*Holcus lanatus*) and daisy (*Bellis perennis*). In some areas crested dog-tail (*Cynosurus cristatus*) was an important component of the vegetation. Other common species in the improved grassland included creeping buttercup (*Ranunculus repens*), mouse ear (*Cerastium fontana*), broad-leaved dock (*Rumex obtusifolius*) and common sorrel (*Rumex acetosa*). Occasionally there were patches of blinks (*Montia fontana*). There were other grasses present at lower abundances including creeping bent (*Agrostis stolonifera*), smooth meadow grass (*Poa pratensis*) and sweet vernal grass (*Anthoxanthum odoratum*). The MG7a grassland was generally devoid of a moss-layer. There were often patches of soft rush (*Juncus effusus*) throughout the improved grassland.

In some of the fields there was evidence of drainage channels. These were usually wet and had an increase in species tolerant to wet conditions such as broad-leaved pondweed (*Potamogeton natans*), yellow iris (*Iris pseudacorus*), common reed (*Phragmites australis*) and water horsetail (*Equisetum fluviatile*).

The improved grassland habitat and MG7 community are not included in the Functional Wetland Typology.

Semi-improved acid grassland

The semi-improved acid grassland was rough pasture grazed by sheep. It was sometimes within stock fences but was also in open grazed areas which transitioned into the bog and heath habitats. This grassland had a taller sward (up to 15cm) and in some areas had much dead grass material.

As was the case for the improved grassland, the semi-improved acid grassland had wet patches, often caused by drainage where there was an increase in water tolerant plants, such as yellow iris, water horsetail and marsh marigold (*Caltha palustris*).

One NVC community was described.

U4a *Festuca ovina – Agrostis capillaris – Galium saxatile* grassland, typical sub-community

The U4a grasslands were usually dominated by a mixture of sheep's fescue and viviparous sheep's fescue. But there was a mixture of other grasses with varying abundances including wavy hair-grass (*Deschampsia flexuosa*), common bent, velvet bent, creeping bent, Yorkshire fog, mat grass and sweet vernal grass.

Photograph 8: The U4a grassland.

Heath rush could be locally abundant especially when this grassland was wetter, or was transitioning into the U6 grassland or bog/heath habitats. Field wood-rush (*Luzula campestris*) was occasionally present.

Frequent forbs in the semi-improved acid grassland included tormentil and heath bedstraw with occasionally some dog violet (*Viola riviniana*) and dandelion.

Unimproved acid grassland

There were several areas of unimproved acid grassland across the Study Area. It was on steep slopes, by streams and in recent peat cuttings. The unimproved acid grassland along-side streams were usually in 2-5m wide strip either side of the stream. Heath rush was the most dominant species but mat grass was very abundant in some stands.

Two NVC communities were described within the unimproved acid grassland category.

U5 *Nardus stricta – Galium Saxatile* grassland community

The U5 grassland was dominated by mat grass with tormentil usually present and heath bedstraw occasional over a layer of woolly fringe moss with some patches of common haircap (*Polytrichum commune*). In damper areas these was accompanied by frequent heath rush, red bog-moss and common haircap as well as occasional heath wood-rush (*Luzula multiflora*). This corresponded well with sub-community U5b. In drier situations the community constants were found with patches of frequent ling heather and woolly fringe-moss, and occasionally deergrass (usually in transitions towards a wet or dry heath community). This was a good match with the U5e sub-community

The U5 grassland was very similar to the U6 grassland (as described below), but differed by the much reduced abundance of heath rush. There were some small patches of heath rush, but it was not constant or abundant. Although, in areas where heath rush became common there was a transition from U5 to U6, the habitat was mapped as a mosaic.

This community could be found on areas of deeper peat, but was generally recorded on shallower peat, often in areas where historic peat cutting appeared to have occurred.

U6 *Juncus squarrosus – Festuca ovina* grassland community

The most common grassland across the Study Area was the U6 heath rush dominated grassland. Heath rush was dominant although, mat grass could be very abundant in some stands.

Photograph 9: The U6 grassland was dominated by heath rush and was the most common grassland in the Study Area.

This community was found along the side of streams, in flushes and at transitions between grassland and heath/bog. It was also found on areas that had been affected by peat cutting activities. Heath rush appeared to be an early colonising species on bare peat and in some areas was strongly dominant forming a mat. This may be an important stage for bog recovery as the heath rush stabilises the peat.

Much of the U6 community had abundant grasses and bog-moss. The grasses and mosses were patchy in their distribution. It was usually on deep peat and was grazed by sheep. Grasses included sweet vernal grass, sheep's fescue and purple moor-grass (*Molina caerulea*) and were supplemented with other graminoids such as common sedge, heath wood-rush and hare's-tail cottongrass. Forbs were not abundant in this community, but included tormentil, heath bedstraw, bog asphodel (*Narthecium ossifragum*) and marsh violet (*Viola palustris*). The ground-layer was dominated by papillose bog-moss, but there was frequently red bog-moss, red-stemmed feather moss, glittering wood-moss and little shaggy-moss.

Where the U6 was found as flushes, bog-mosses and little shaggy–moss were key component of the vegetation (red bog-moss and papillose bog-moss). There were often small tussocks of common cottongrass and hare's-tail cottongrass. Soft rush and bulbous rush could be abundant particularly close to the water's edge.

Where this community was found along-side streams it was usually 2-5m wide either side of the stream. There was an increase in grasses, particularly common bent and mat grass was often much less abundant. Soft rush and bulbous rush could be abundant in damp tussocks. Common haircap was found beside the streams with occasionally some bog-mosses. Forbs were mainly heath bedstraw and tormentil.

Unimproved calcareous grassland

Unimproved calcareous grassland was confined to one strip on the southern edge of the Study Area. The bedrock in this location was not limestone, but a Lewisian Gneiss (metamorphic bedrock, BGS, 2015). The base enrichment would likely be caused by flushing with base-rich water or from base-rich superficial deposits. This is common at the foot of the upland habitats already described (Rodwell, 1992).

One NVC community was described.

CG10 Festuca ovina – Agrostis capillaris – Thymus praecox grassland community

The CG10 grassland community was a dry closely cropped sward above an improved pasture fields. It was on shallow, sloping soils that transitioned gradually into dry heath as the abundance of ling heather increased.

Photograph 10: The CG10 community was a dry closely cropped sward.

There was a higher species richness in the CG10 community than other grassland. The most common graminiods were common bent, viviparous sheep's fescue, sheep's fescue, sweet vernal grass and Yorkshire fog. There were also wetter areas where heath grass (*Danthonia decumbens*) was more prevalent. Mat Grass was occasional in the sward.

Ling heather was present, but thyme was constant and abundant giving the community its identity. Herb species such as selfheal (*Prunella vulgaris*), dog violet, common sorrel, heath bedstraw, heath wood-rush and field wood-rush were all frequent or abundant, and tormentil and devil's-bit scabious (*Succisa pratensis*) was occasionally recorded which corresponded well with the dry CG10a sub-community. In the wetter areas, thyme was still abundant, though other species such as bird's-foot trefoil (*Lotus corniculatus*), flea sedge (*Carex pulicaris*), ribwort plantain (*Plantago lanceolata*), eyebright (*Euphrasia spp.*), and marsh violet were all recorded. This was a good match for the wetter flushed CG10b sub-community.

Little shaggy moss, glittering wood-moss and common haircap were all recorded frequently present within the community.

Montane grassland

Montane grasslands as defined by the Functional Wetland Typology are wet areas of very short dense vegetation includes the U4a, U5, U6 and CG10 grasslands (SNIFFER, 2009b).

Marshy grassland

The marshy grassland was found along the river channels where the vegetation was wetter than the surrounding habitats. It was dominated by soft rush, with frequent Yorkshire fog and creeping bent over a moss layer of common haircap and papillose bog-moss. Heath bedstraw, tormentil and marsh violet were occasional forbs.

Two NVC communities were described.

MG10a Holcus Lanatus – Juncus effusus rush-pasture, typical community

There were small areas, along the river channels that were wetter than the surrounding vegetation. These were best classified as the MG10a Yorkshire fog–soft rush pastures. They were dominated by soft rush over a moss layer of common haircap and papillose bog-moss. Yorkshire fog and creeping bent commonly present at low abundances. Heath bedstraw, tormentil and marsh violet were occasional forbs.

M28a Iris pseudacorous – Filipendula almaria mire community

There were several small areas of the yellow iris dominant mire M28a. This was within small drainage channels within the grassland communities. The channels were sometimes flowing into streams, or were part of a field system. Yellow iris dominated often almost entirely, but there was also some marsh marigold, soft rush and bittercress (*Cardamine hirsuta*). The M28a mire community was too small to map, but have been target noted.

Marshy grassland

Marshy grassland, as described by the Functional Wetland Typology, includes vegetation dominated by tussock forming grasses and rushes in damp soils. The Phase 1 Habitat marshy grassland and NVC communities MG10 and M28 fit into this category.

Acid flush

The acid flush habitats were recorded in a number of locations across the Study Area. They were usually too small to be mapped and were recorded as target notes. Two NVC communities were recorded.

M6 Carex echinata – Sphagnum fallax/denticulatum mire community

This community was recorded as part of a slow flowing flush beside the Horse Water. There was an extensive carpet of bog-moss sitting at or just above the water table, with cow-horn bog-moss, flat-topped bog-moss and papillose bog-moss. There were also patches of common haircap. Sedges were the most common vascular plants growing through this lawn of bog-moss, including abundant common sedge (*Carex nigra*) as well as more scattered star sedge (*Carex echinata*). Common cottongrass was also very frequent. Rushes were less common, but included patchy sharp-flowered rush (*Juncus acutiflorus*), Bulbous rush and, in drier areas, heath rush. Also in drier areas were clumps of mat grass. Forbs were uncommon, but included round-leaved sundew tormentil.

M29 Hypericum elodes – Potamogeton polygonifolius soakaway community

The M29 community was recorded in a number of locations across the Study Area. They were usually far too small to be mapped and were target noted. Although, there were two locations where it was large enough to map.

The community was dominated by bog pondweed (*Potamogeton polygonifolius*) with lesser spearwort (*Ranunculus flammula*) and bulbous rush, over a patchy carpet of cow-horn bog-moss. Bottle sedge (*Carex rostrata*), common sedge, common cottongrass, round-leaved sundew and bog asphodel were also occasionally found.

The M29 community was associated with areas of very sluggish water movement adjacent to pools or larger bodies of standing open water or flowing in diffuse channels, and this irrigation allowing a slightly more diverse flora to develop. Where this lateral water movement ceased and the water became stagnant, the community tended back to the more species-poor M1 community as species such as bog pondweed and lesser spearwort were lost.

Seepage/flush

In the Functional Wetland Typology seepage/flushes are defined as variable vegetation associated with diffuse springs on hill slopes. This is similar to the Phase 1 Habitat acid flush and the NVC community M6 and M29 which was found in some locations across the Study Area.

Open water

There were several small lochs and lochans within the Study Area: Evra Water, Litla Water, Horse Water, Swarta Shun, Loch of East Yell and Loch of Kettlester which were in the east of the Study Area. The open water was shallow with a peaty substrate (and so was dystrophic). Occasionally rocks were seen below the water.

Running water

The running water was in the form of streams running through the valleys. The largest of which were the Burn of Hamnavoe and the Burn of Sundrabister which ran through Canis Dale and Aris Dale respectively. They were usually less than 1m wide at higher altitudes, and became broader, meandering and slower flowing at lower altitudes and gradients. The banks of the streams were usually of unimproved acid grassland.

Intertidal

There were small intertidal areas in the south of the Study Area. These were mainly of shingle and stone (2cm -10cm diameter). Thrift (*Armeria maritima*) and buck's horn plantain (*Plantago coronopus*) were the main colonising species which were at the edge of the intertidal zone.

Bare ground

Bare ground was recorded where there was exposed rock, gravel or rubble.

Matrixes

Many matrixes were mapped within the Study Area. This is mainly due to the high proportion of bare peat found with many habitats which was mapped appropriately.

Evaluation

Groundwater Dependant Terrestrial Ecosystems

Most of the habitats and communities within the Study Area are not considered likely to be wetlands or GWDTE. However, SEPAs Guidance Note (2012) recommends that the NVC communities U6, M6, M15, M28, M29, MG10 and CG10 should be treated as GWDTE unless information can be provided to demonstrate they are not dependent on groundwater. SEPA (2012) does recognise that some of these communities are common across Scotland (e.g. M6, M15 and MG10). SEPA (2012) also recognises that these communities may be considered GWDTEs only in certain hydrogeological settings, or may have limited dependency on groundwater in certain hydrogeological settings.

The bedrock below the Study Area includes Lewisian gneiss and Aridale Quartzite and a variety of schists and psammites (for more details refer to **Chapter 13: Geology**). This metaphoric bedrock is a low productive aquifer where the groundwater is near the surface (For more details refer to **Chapter 15: Hydrology and Hydrogeology**). Ground Investigation (GI), work with the use of boreholes, would take place post consent and prior to construction (For more details refer to **Chapter 15: Hydrology and Hydrogeology**).

In general, habitats can have water derived from three main sources; rainwater, surface water or groundwater. Rainfall in Yell is high (**Chapter 15: Hydrology and Hydrogeology**)

and most of the Study Area formed part of a peat bog system, and so is ombrogenous (dependant on rainwater). Habitats adjacent to streams or lochs/lochans will have water derived from these surface waters (as well from other sources such as rainwater). Therefore, those habitats that were part of the peat bog system, and/or alongside surface water influences were considered likely to be either not groundwater dependant, or to have a low dependency on groundwater as they will be supported by water from other sources (namely the surface water and/or rainwater).

Table 2 illustrates the relationship between NVC communities, Phase 1 Habitats, Functional Wetland Typologies and the likelihood of groundwater dependency.

ES Volume 2: Figure 11.5 displays GWDTE in relation to the Development layout with a 250m buffer around all the construction elements. SEPA's Guidance (Note 31) recommends a 100m buffer around roads and a 250m buffer around turbines and other infrastructure. However, as there is the potential for the excavations to be greater than 1m (**Chapter 3: Project Description, ES Volume 2: Figure 3.10**), and so a 250m buffer has been displayed around all infrastructure. For more details see **Annex 11.2.1**

Phase 1 Habitat	NVC Community	Functional Wetland Typology Category	SEPA's Guidance GWDTE	Landscape Setting and Situation within Study Area	Resultant GWDTE
Dry modified bog	N/A	Peat bog	Not a GWDTE	N/A	Not a GWDTE
Wet modified bog	N/A	Peat bog	Not a GWDTE	N/A	Not a GWDTE
Unmodified blanket bog	M1, M2, M3, M18, M19 and M20	Peat bog	Not a GWDTE	N/A	Not a GWDTE
Unimproved acid grassland	U5 U6	Montane grassland	Not a GWDTE Moderately GWDTE depending on hydrological setting	N/A Where the U6 was found at transitions between grassland and peat bogs or in areas affected by peat cutting activities it was considered be part of the peatland system and fully ombrogenous. Where the U6 community was found along stream sides, within the peat bog system, it was considered it would have water inputs from the surrounding ombrogenous peatlands and adjacent surface water but it was possible to have a low dependency on groundwater and water tables are generally higher besides surface water.	Not a GWDTE Not a GWDTE Low GWDTE
Dry dwarf shrub heath	H10, H14	Not a wetland	Not a GWDTE	N/A	Not a GWDTE
Improved grassland	MG7	Not a wetland	Not a GWDTE	N/A	Not a GWDTE
Semi-improved acid grassland	U4	Not a wetland	Not a GWDTE	N/A	Not a GWDTE
Wet dwarf shrub heath	M15	Wet heath	Moderately GWDTE depending on the hydrological	Where the M15 was located within areas the peat bog system and/or was formed as part of the historic peatland management it was	Not a GWDTE

Phase 1 Habitat	NVC Community	Functional Wetland Typology Category	SEPA's Guidance GWDTE	Landscape Setting and Situation within Study Area	Resultant GWDTE
			setting	considered likely to be rainwater fed. The areas of M15 not within the peatland system were found to be relatively dry and stony. Therefore, it was thought to be unlikely to be GWD or have low dependency at best. Where the M15 was wetter it was considered possible that there was some groundwater dependency	Not a GWDTE Low GWDTE
Marshy grassland	MG10, M28	Marshy grassland	Moderately GWDTE depending on hydrological setting	These two communities were located by surface water (i.e. by streams/ditches), and they were within the peatland system (ombrogenous).	Low GWDTE
Buildings and roads	Buildings and roads	Not a wetland	Not a GWDTE	N/A	Not a GWDTE
Bare ground	Bare ground	Not a wetland	Not a GWDTE	N/A	Not a GWDTE
Unimproved calcareous grassland	CG10	Montane grassland	Highly GWDTE	The CG10 was surrounded by dry heath, with no surface water present and so was considered likely to be highly groundwater dependant.	High GWDTE
Acid flush	M6, M29	Flush/seepage	Highly GWDTE (depending on hydrological setting)	The M29 and M6 in the study area was adjacent to a Horse Water (surface water) and within the peatland system (ombrogenous). These communities were at the level of the surface water and very wet. So may have been moderately GWD.	Moderate GWDTE

Table 2: *The relationship between Phase 1 Habitats, NVC communities, Functional Wetland Typology categories and the likelihood they are GWDTE*

Habitat Evaluation

No parts of the Study Area are designated as protected areas for habitats.

Active, peat forming blanket bog is listed by European legislation, under Annex 1 of the Habitats Directive (Directive on the Conservation of Natural Habitats and Wild Fauna and Flora EC/92/43). Some of the unmodified blanket bog habitat in the Study Area could be described as approaching 'active' using Annex 1 definitions. However, a vegetation survey provides only limited information on which to assess whether blanket bog is actively peat forming or not. Where there was a deep continuous layer of bog-moss species and an abundance of hare's-tail cottongrass the blanket bog was likely to be active. At higher altitudes blanket bog with extensive erosion features may still be classified as 'active' if it otherwise supports extensive areas of typical bog vegetation, especially if the erosion gullies show signs of re-colonisation (Maddock, 2008). Therefore, on balance, a small amount of the blanket bog habitats in the Study Area should be treated as possibly approaching Annex 1 European habitat descriptions.

There is 2,200,000ha (22,000km^2) of blanket bog in the UK (JNCC, 2015; JNCC 2012) and 1,759,000ha (17,590km^2) in Scotland (JNCC, 2015). There appears to be no data published showing the amount of blanket bog on a regional scale (i.e. in Shetland). This Study Area had 130ha (1.30km^2) of unmodified blanket bog habitat. Although some of the unmodified blanket bog is approaching both UK BAP and Annex 1 habitat definitions, there is much less than 1% of the national total (0.006%), and therefore the quantity/size present is not considered to be of national, European or international importance. Blanket bog (or peatland) is a ubiquitous habitat across Shetland as a region (SNH, 2002). Therefore, the area of blanket bog within the Study Area was considered to be of local importance.

The dry dwarf shrub heath, H14 is an alpine heath and the H10 is a boreal heath. H14 is included in the UK BAP priority habitat mountain heaths and willow scrub and H10 is included in the UK BAP priority habitat upland heath. Both are included in the Annex 1 habitat alpine and boreal heath. UK BAP mountain heaths and willow scrub includes heaths dominated by ling heath and bilberry with abundant woolly fringe moss and/or lichens with stiff sedge (Maddock, 2008). Annex 1 alpine and boreal heath is defined as dwarf shrub heaths of ling heather, bilberry or juniper which are low growing or prostrate (JNCC, 2015). The H14 community on the top of the hills within the Study Area was equivalent to these definitions.

There is estimated to be 60,000ha of mountain heaths and willow scrub in Scotland (Maddock, 2008) and 42,100ha of alpine and boreal heath in the UK (JNCC, 2015). There appears to be no data published showing the amount of heath in Shetland. There was 37ha of H14 within the NVC Study Area; this is 0.06% and 0.09% of the mountain heath and willow scrub and alpine and boreal heath respectively. Heathlands are also known to be

common habitats in Shetland (SNH, 2002). Therefore, the quantity and condition of the H14 community suggests it should be evaluated as of local importance.

Annex 1 European dry heath includes dwarf shrub dominated vegetation with ling heather, bilberry and bell heather (JNCC, 2015). Some of the H10 dry dwarf shrub heath may have been approaching these definitions, but it was found in small patches, within a matrix of acid grassland. There is 608,000ha (6,080km^2) of dry dwarf shrub heath in the UK (JNCC, 2015). There was 24ha of H10 the within the Study Area which is much less than 1% (0.0004%) of the total. Therefore, the H10 was not considered to be of sufficient quantity or quality to be regionally, nationally or internationally important and was evaluated as being of local importance.

UK BAP wet dwarf shrub heath (within the upland heath BAP habitat) in favourable condition is defined as 'dominated by a mixture of cross-leaved heath, deergrass, ling heather and purple moor-grass over an understorey of bog-moss' (Maddock, 2008). Annex 1 Northern Atlantic wet heath includes M15 including wet heath (JNCC, 2015). There is 462,000ha (4,620km^2) of wet dwarf shrub heath in the UK (JNCC, 2015). There appears to be no data published showing the amount of wet heath in Shetland. There was 22ha of wet dwarf shrub heath within the Study Area, which is much less than 1% (0.004%) of the total. Wet heaths are common habitats on Shetland (SNH, 2002). Therefore, the wet dwarf shrub heath was evaluated as being of local importance.

Other NVC communities identified during the survey work are listed in the UK BAP Priority Habitat Descriptions (Maddock, 2008), e.g. M6, M28, M29 and CG10. However, as with the heath communities, the very small size of the areas of each of these communities in the Study Area renders them of little importance on a regional, national, European or international scale. Therefore they are evaluated as being, at best, of local importance.

Species Evaluation

Alpine bearberry was found in the dry dwarf shrub heath. It is listed as national scarce, however, the scarcity of this species within the Study Area makes it important for the site, but the population size was not deemed to be of regional or national importance. Therefore, it was judged to be of local value.

None of Shetland's endemic plant species were recorded within the Study Area.

No other rare species were located within the Study Area.

Discussion

A total of 17 Phase 1 Habitats with 14 matrixes and 17 NVC communities and sub-communities were found and described using standard survey methods within the Study Area. These habitats were all typical of the Scottish uplands and Shetland. Of the habitats

present, dry modified bog was the most common habitat making up 39% of the Study Area. This was followed by wet modified bog which made up 25% of the Study Area. Wet and dry modified bogs are highly modified habitat types which do not have NVC communities assigned to them. Wet modified bog was often characterised by deep hagging and bare peat, the dry modified bog was more similar to dry heath vegetation of deep peat with little to no bog-mosses present. Unmodified blanket bog, which made up 8% of the Study Area, is a UK BAP priority habitat and is highlighted in the LBAP.

The Study Area held typical upland habitats, communities and plant species. The dry dwarf shrub heath was considered to be of high quality. The quantity of this habitat within the study was small. This community was considered to be of local importance. Some of the unmodified blanket bog was considered to be of relatively good quality. However, the quantities of the habitats present in the Study Area were relatively small given their widespread occurrence across much of the Shetland. Consequently, these habitats were evaluated as of local importance.

Across the site there was extensive hagging and areas of exposed peat and areas with clearly deep peat, but next to no bog-mosses present. Consequently, most of the Study Area was classified as either wet or dry modified bog. Although hagging is likely to have developed through natural causes, some of the hagging and the low levels of re-colonisation by vegetation are likely to have been exacerbated by heavy trampling and sheep grazing. The effects of drainage and peat cutting are likely to have reduced the bog-mosses present on the Study Area resulting in large areas of dry modified bog.

Some of the Study Area was defined as wetland habitat. The NVC communities U6, M6, M15, M28, M29, MG10 and CG10 should be treated as potential GWDTE. Only NVC community CG10 was considered likely to be highly groundwater dependant.

When assessing the potential impact of the Beaw Field Wind Farm, the presence and importance of the habitats present should be considered. Special attention should be paid to the alpine dry dwarf shrub heaths which are Annex 1 priority habitats. Special attention should also be paid to the unmodified blanket bog which is an Annex 1 priority habitat when in ‘good condition’ (as was the case for a small amount of the of the unmodified blanket bog recorded) and the CG10 community that was considered highly groundwater dependant.

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Annex 11.2.1

Appendix 2: Checklist for Submitted Information - Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (GWDTE)

	Information Requirements	Circle to confirm	ES reference: Figure / Section	SEPA Actions
1	Plans showing all proposed infrastructure, including temporary works	(Yes)	Figure 3.1 of the ES	If not provided – SEPA will object due to lack of information and request the required plans
2	Plans overlain with details of the extent and depths of all proposed excavations	(Yes)	Chapter 3 figures shows the design of the development.	If not provided – SEPA will object due to lack of information and request the required plans
3	Plans show the relevant specified buffer zones (100m and 250m)	(Yes)	Figure 11.5 of the ES	If not provided – SEPA will object due to lack of information and request the required plans
4	Plans overlain with source of groundwater abstractions: - all groundwater abstractions within 100m radius of all excavations shallower than 1m - all groundwater abstractions within 250m of all excavations deeper than 1m Or statement provided to confirm none	(Yes)	No ground water abstractions are present within 250m of the development see Chapter 15 of the ES.	If not provided - SEPA will object due to lack of information and request the required plans
5	Plans overlain with GWDTE (Phase 1 habitat survey) data: - within 100m radius of all excavations shallower than 1 m; - within 250m of all excavations deeper than 1m. Or statement provided to confirm none	(Yes)	Figure 11.5 of the ES	If not provided – SEPA will object due to lack of information and request the required plans
6	Applicant confirmation of one of following (as shown on above plans): i) no groundwater abstractions and GWDTE on site; ii) groundwater abstractions and/or GWDTE identified and 250m buffer zones implemented iii) confirmation that the groundwater abstraction owners have agreed contingency plans including temporary or permanent replacement of a groundwater supply.	(Yes)	Potential GWDTE identified and 250m buffer zones implemented	If confirmed SEPA will request condition A (maintenance of buffer zones) as specified in SEPA guidance note Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems
7	Applicant can confirm above plans show excavations or intrusions within 100m buffer zone are shallower than 1m	(Yes)	No, excavations are deeper than 1m	If confirmed SEPA will request condition B (monitoring) as set out in above guidance
8	Applicant can confirm above plans show excavations or intrusions are on/in a groundwater abstraction or GWDTE	(Yes)	Figure 11.5 of the ES	If confirmed SEPA will require a bespoke risk assessment
9	Applicant can confirm infrastructure involves excavations deeper than 1m within 250m of sensitive receptors or unable to comply with monitoring requirements of Condition B	(Yes)	Infrastructure involves excavations deeper than 1m within 250m of potentially sensitive receptors.	If confirmed SEPA will require a bespoke risk assessment

10	Bespoke risk assessment provided	Yes	Annex11.2. 1 of the ES.	SEPA will provide a bespoke response
Signature: [redacted]	Organisation: Wardell Armstrong			Date: 15/02/2016

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PEEL WIND FARM (YELL) LTD

Beaw Field Wind Farm

Annex 11.2.1 Groundwater Dependent Terrestrial Ecosystems (GWDTE) Risk Assessment

March 2016

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Figure A11.2.1 Horse Water GWDTE Zone of Contribution

1 INTRODUCTION

1.1.1 Wardell Armstrong LLP have been commissioned to undertake a Groundwater Dependant Terrestrial Ecosystems (GWDTE) risk assessment, on behalf of Peel Wind Farms (Yell) Ltd, relating to a planning application for the proposed Beaw Field Wind Farm, Yell, Shetland Islands.

1.1.2 Groundwater Dependant Terrestrial Ecosystems (GWDTE) are protected under the Water Framework Directive. Excavations and development infrastructure, such as roads and foundations, can impede groundwater flow, which can potentially impact upon habitats that are GWDTE.

1.1.3 SEPA's Guidance Note 311 (SEPA, 2014) recommends that a series of steps are followed to ensure potential risks to GWDTE are assessed. These steps include:

- a Phase 1 Habitat Survey;
- wetlands identified by use of the Functional Wetland Typology;
- an NVC survey;
- identification of all GWDTE within a) 100m of all excavations less than 1m in depth, or b) 250m of all excavations greater than 1m in depth; and
- a qualitative and/or Quantitative risk assessment of all GWDTE within these buffers.

1.1.4 This annex provides details of the potential GWDTE within a 250m buffer zone of the Proposed Development and assess the likelihood of the potential GWDTE being impacted by the Proposed Development.

1.2 Background

1.2.1 Phase 1 Habitat Survey and NVC surveys were conducted in April 2012 and August 2015 by Alba Ecology Ltd. As part of these surveys wetland habitats were recorded in line with the Functional Wetland Typology (for details of these surveys see ES Volume 2: Appendix 11.2). Using this data and SEPA's guidance notes (SEPA, 2014[2] and SEPA, 2014[1]) GWDTE were assessed (ES Volume 2: Appendix 11.2).

[1] Scottish Environmental Protection Agency (2014), Guidance Note 31: Guidance on Assessing the Impact of Windfarm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems (Reference LUPS-GU31).

[2] Scottish Environmental Protection Agency (2014), Guidance Note 4: Planning Guidance on Windfarm Developments. (Reference LUPG-GU4).

1.2.2 Most of the habitats and vegetation communities within the study area are considered not to be wetlands and/or not potential GWDTE. This is mainly because much of the Site is an ombrogenous peatland. However, there are several communities that were assessed as potentially having some groundwater dependency (see Table 1). Whether these communities are dependent upon groundwater is conditional upon the hydrological setting. Those considered of no groundwater dependency, or potentially low groundwater dependency are not considered further as they are highly unlikely to be substantially impacted by the Proposed Development. Those that are potentially moderately or highly groundwater dependant are considered further.

1.2.3 ES Volume 2: Figure 11.5 displays GWDTE in relation to the Proposed Development layout with a 250m buffer around all the construction elements. SEPA's Guidance recommends a 100m buffer around roads and a 250m buffer around turbines and other infrastructure. However, as there is the potential for the excavations to be greater than 1m (Chapter 3: Project Description) due to deep peat across the study area is was deemed appropriate to use a 250m buffer area around all infrastructure.

Table 1: The Potential GWDTE in the Proposed Development

Phase 1 Habitat	NVC Community	Functional Wetland Typology Category	SEPA's Guidance Note 31 GWDTE Groundwater Dependency	Landscape Setting and Situation within Study Area	Resultant Potential GWDTE Groundwater Dependency
Unimproved acid grassland	U6	Montane grassland	Moderately GWDTE depending on hydrological setting	Where the U6 community was found along stream sides, within the peat bog system, it was considered it would have water inputs from the surrounding ombrogenous peatland and adjacent surface water but it was possible to have a low dependency on groundwater and water tables are generally higher besides surface water.	Low GWDTE
Wet dwarf shrub heath	M15	Wet heath	Moderately GWDTE depending on the hydrological setting	Where the M15 was wetter it was considered possible that there was some groundwater dependency.	Low GWDTE
Marshy grassland	MG10, M28	Marshy grassland	Moderately GWDTE depending on hydrological setting	These two communities were located by surface water (i.e. by streams/ditches), and they were within the ombrogenous peatland.	Low GWDTE

Table 1: The Potential GWDTE in the Proposed Development					
Phase 1 Habitat	**NVC Community**	**Functional Wetland Typology Category**	**SEPA's Guidance Note 31 GWDTE Groundwater Dependency**	**Landscape Setting and Situation within Study Area**	**Resultant Potential GWDTE Groundwater Dependency**
Unimproved calcareous grassland	CG10	Montane grassland	Highly GWDTE (depending on hydrological setting)	The CG10 was surrounded by dry heath, with no surface water present and so was considered likely to be highly groundwater dependant.	High GWDTE
Acid flush	M6, M29	Flush/seepage	Highly GWDTE (depending on hydrological setting)	The M29 and M6 in the study area was adjacent to a Horse Water (surface water) and within the ombrogenous peatland. These communities were at the level of the surface water and very wet. So may have been moderately GWD.	Moderate GWDTE
Note: The full details of all the Phase 1 Habitats and NVC communities and the full evaluation of all their potential groundwater dependencies can be found in ES Volume 2: Appendix 11.2.					

2 ASSESSMENT

2.1.1 SEPA requires detailed mapping of GWDTE that are within the 250m buffer zone of the Proposed Development infrastructure and an assessment of the likelihood the GWDTE will be impacted and any suggested mitigation.

2.1.2 This has been achieved through the following steps:

- an identification of potential 'at risk' GWDTE;
- a conceptual model of the hydrology on the Site;
- assessing the impacts; and
- determining suitable mitigation measures.

2.2 Identification of Potential 'at Risk' GWDTE

2.2.1 The likelihood that potential GWDTE are 'at risk' due to the Proposed Development depends on a number of factors:

- the distance between the potential GWDTE and the Proposed Development;
- the location of the potential GWDTE in relation to the Proposed Development (i.e. upslope or downslope of the Proposed Development); and
- the nature and activities of the Proposed Development.

2.2.2 Potential GWDTE are most 'at risk' in areas at where there is the potential for the direct loss or alteration to a potential GWDTE or its water supply and also in areas where pollutant substances (e.g. concrete, oil and fuel) would be used, such as the turbine foundations, borrow pits and site compound.

2.2.3 Potential GWDTE habitats, as shown on Figure A11.2.1 and Figure 11.5 of the ES, which are located further than 250m from the Proposed Development are unlikely to be affected by the Proposed Development in terms of disruption or loss of their water supply and their risk of being affected by contaminated water. The distance between the potential GWDTE and the Proposed Development would encourage dilution if a pollution event, such as an oil or fuel spill from a vehicle, were to occur. In addition the hydraulic connectivity between the turbine foundations and borrow pits in terms of groundwater flow pathways is likely to be low due to the low productivity[3] of the underlying metamorphic bedrock and due to the excavations for the borrow pits and turbine foundation being above the bedrock water table.

2.2.4 Potential GWDTE which are within 250m of the Proposed Development, but are located upslope of Proposed Development are unlikely to be affected if excavations are relatively shallow compared to the saturated thickness of the underlying bedrock aquifer as a substantial drawdown of the aquifer is considered improbable. In addition, as discussed above the excavation for the turbine foundations and borrow pits would be above the bedrock water table, therefore the Proposed Development is unlikely to change the prevailing rates of groundwater flow. Post-consent hydrogeological Site Investigation would confirm the Site groundwater levels and flow pathways.

2.2.5 The only potential moderate or highly groundwater dependant GWDTE located within 250m and downslope of the infrastructure are the potentially moderately dependant GWDTE communities M6 and M29 located adjacent to the shore of Horse Water loch as shown on Figure A11.2.1 and ES Volume 2: Figure 11.5.

2.3 Conceptual Hydrological Site Model

2.3.1 Plate 1 shows the potential GWDTE Conceptual Site Hydrological Model (CSHM). The CSHM shows the conceptual water movement pathways through the peat, superficial deposits and the bedrock geology of the Site. There are three main pathways: surface

[3] British Geological Survey (2015) Geoindex Onshore: Hydrogeology 1:625,000 Scale Map [online]. Available at: http://mapapps2.bgs.ac.uk/geoindex/home.html

runoff, peat/till water movement (infiltration, throughflow, percolation), and groundwater flow.

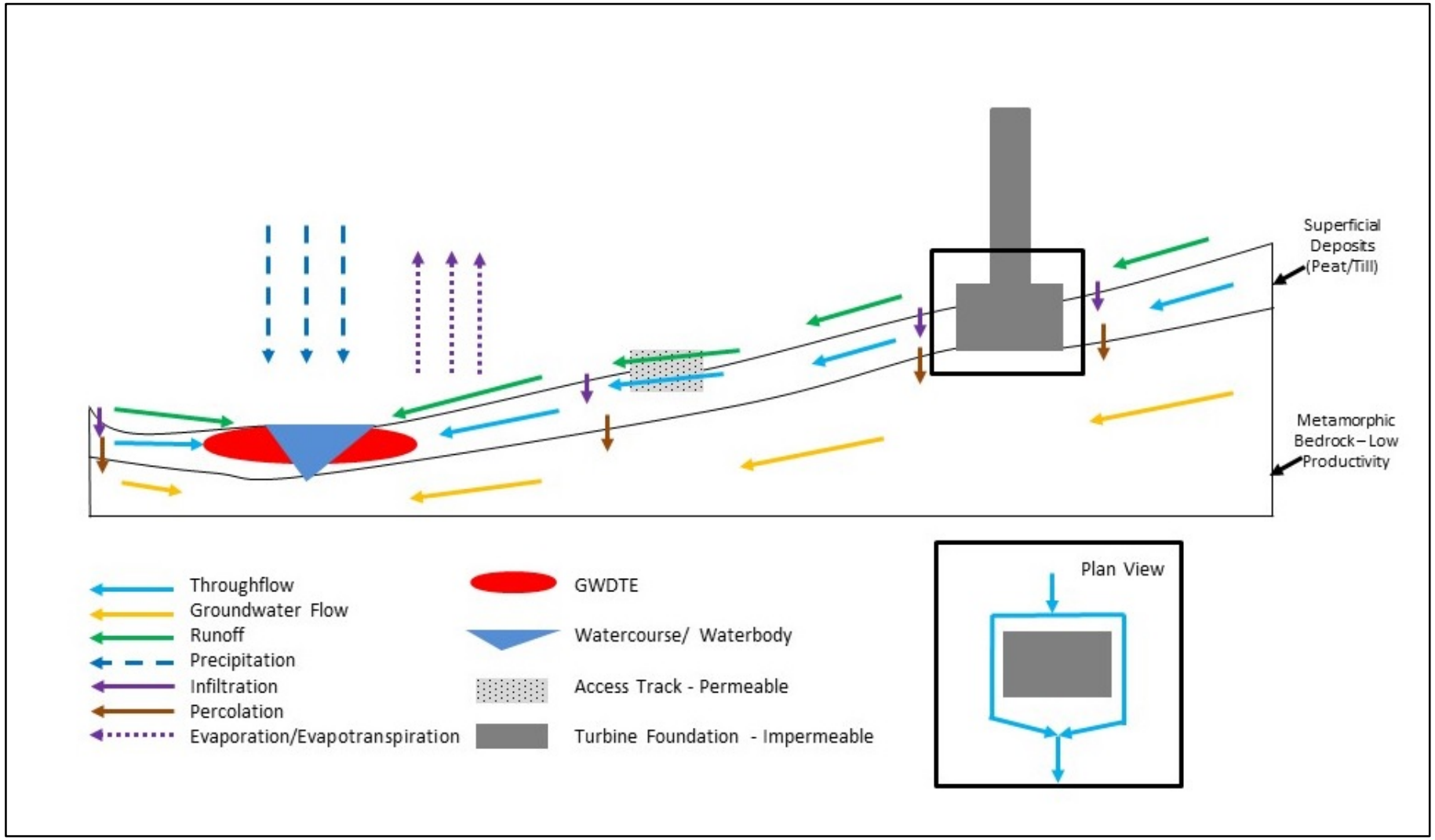

Plate 1: Potential GWDTE Conceptual Site Hydrological Model (CSHM)

2.3.2 Peat has high water retention and pseudo-aquifer properties; and is often saturated which enhances the conditions for surface runoff. The clay content of the underlying glacial till can impede the vertical movement of water leading to frequent peat saturation and the promotion of surface runoff during wet periods.

2.3.3 The CSHM suggests that the potential GWDTE within the Site are predominantly maintained by water contained within the peat rather than the bedrock aquifer. The water in the peat is fed by two main water pathways. The first pathway is surface runoff from the surrounding hillsides. The second pathway is sub-surface throughflow within the peat. The high clay content of the underlying till is likely to impede the vertical percolation of water into the metamorphic bedrock. The high organic content of the peat and its hydraulic connectivity with surrounding peat deposits would facilitate lateral throughflow, allowing water to move towards the -surrounding vegetation.

2.3.4 The CSHM suggests that the potential GWDTE, as identified on ES Volume 2: Figure 11.5 across the Site are not actual GWDTE. This is because their water supply is from surface water and water in the peatlands and not from the bedrock aquifer, therefore no further assessment is required.

3 MITIGATION

3.1.1 Although the CSHM has shown that the habitats across the Site are unlikely to be groundwater fed, these areas may still be impacted by the Proposed Development from releases of polluting substances or by changes in the local hydrology and as such mitigation measures to avoid or minimise the potential impacts of the Proposed Development on these habitats are provide in Table 2. Good practice mitigation measures are described in Appendix 3.6: Outline Construction Environment Management Plan of the ES.

Table 2: Mitigation Measures
General
Micro-siting of infrastructure away from the sensitive habitats will be undertaken where possible.
Groundwater and surface water drainage arrangements for construction elements will be in line with the principles of sustainable drainage systems (SuDS) by incorporating appropriate attenuation and treatment. This approach will be in line with the SuDS Manual (C697) published by CIRIA[4] and the CAR Practical Guide[5].
Excavations for Turbine Foundations, Borrow Pits, Substation and Construction Compounds
The time any excavation is open will be kept to a minimum to avoid ingress of water and dewatering.

[4] Construction Industry Research and Information Association (2007) C647 The SUDS Manual

[5] Scottish Environmental Protection Agency (2014), The Water Environment (Controlled Activities) (Scotland) Regulations 2011 (as amended): A Practical Guide.

Table 2: Mitigation Measures
Temporary cut-off drains will be installed to prevent surface water and shallow throughflow entering excavations. Treated water will be discharged downstream of the excavation and encouraged to infiltrate into the ground mimicking natural flow patterns.
Drainage or pumping from excavations will be minimised through appropriate design such as the use of temporary cut-off drains and minimising the construction period.
Runoff and any water pumped from excavations in proximity to sensitive habitats will be discharged near to the excavation thereby retaining natural flow patterns and utilising the nature treatment potential of existing vegetation and peat. Infiltration of flows will be encouraged (e.g. use of swales) and the concentration of flows at the discharge point(s) will be avoided to prevent scouring.
Excavations will be reinstated as soon as practicable once construction works are complete and will ensure that natural hydrological conditions are restored as far as possible.
Track Construction and Drainage
All new and upgraded access tracks will be constructed with a suitable camber and will have a permeable, granular surface.
Access tracks will be constructed from material of a benign chemistry i.e. that will not have an adverse impact on the local soil/groundwater chemistry.
Where the access tracks are oriented parallel to the dominant flow direction, transverse drains ('grips') will be constructed, where appropriate, in the surface of the access track to convey runoff into adjacent drainage ditches. This will help prevent the tracks from acting as a preferential flow path for surface runoff.
Where access tracks are oriented perpendicular to the dominant flow direction the trackside drainage will include a lateral drainage channel cut along the uphill side of the track to intercept the natural runoff and shallow throughflow and this will be conducted under the track at regular intervals through cross drainage pipes. The trackside drains will be broad and shallow with moderate gradients to prevent scouring. Flows from this drainage will be treated by filtration through check dams and settlement at sumps.
Where appropriate, swales will be used along the access tracks to hold water temporarily and to encourage infiltration/discharge into the ground locally. Check dams will be placed regularly along the swales to reduce flow velocities and maximise infiltration.
All existing land drainage passing under the tracks will be preserved or reinstated to ensure that the existing, drainage regimes are maintained. This includes all watercourses, drains, flushes, springs and peat pipes.
All new and upgraded access tracks will be constructed with a suitable camber and will have a permeable, granular surface.
During the operation phase, any drains associated with access tracks will be inspected periodically and cleaned out as necessary.
Oil, Fuel, Concrete and Vehicle Use and Storage
Oil and fuel storage areas, if required, will be impermeable and bunded.
No fuelling or maintenance of vehicles and machinery will be carried out within a sensitive habitat and cleaning of tools will be carried out in a designated area in line with Pollution Prevention Guideline 7: The Safe Operation Of Refuelling Facilities.
Spill kits will be kept onsite in easily accessible and signed locations.
Regular inspection and maintenance of vehicles, tanks and bunds will be undertaken. The Pollution Incident Response Plan or similar for the Site will include measures to deal with any accidental spillages
Pouring of concrete for turbine bases will take place within well shuttered pours to prevent egress of concrete from the pour area
Pouring of concrete during adverse weather conditions will be avoided.
Concrete pH will be as close to background pH as practicable.
Ecological Mitigation
Appendix 10.4: Outline Habitat Management Plan (OHMP) described the plan for large scale blanket bog restoration, primarily by reducing grazing pressure throughout the Application Boundary. This would have direct and indirect benefits to sensitive habitats, through reduced grazing on the sensitive habitat itself, and through a more natural hydrological state in restored blanket bog.
Best practice techniques of vegetation and habitat reinstatement would be adopted and implemented in areas of disturbed vegetation, such as track sides and borrow pits. Early restoration of all disturbed areas (e.g. through hydro-seeding) would be undertaken to minimise the risk of peat erosion.