TA6.1 National Vegetation Classification & Habitats Survey

Glenshero

National Vegetation Classification & Habitats Survey

Technical Appendix 6.1

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EXECUTIVE SUMMARY

MacArthur Green was commissioned by RES Ltd on behalf of Simec Wind One Ltd to carry out and report on National Vegetation Classification (NVC) and habitat surveys at the proposed Glenshero Wind Farm site approximately 13km west of Newtonmore (hereafter referred to as 'the proposed development').

The aim of the NVC survey is to identify and map the vegetation communities present within the NVC study area in order to identify those areas of greatest ecological interest (i.e. Annex I habitats; potential Groundwater Dependent Terrestrial Ecosystems (GWDTE), and Scottish Biodiversity List (SBL) priority habitats). This information is used to inform the wind farm design process and the ecological assessment for the Glenshero Environmental Impact Assessment Report (EIAR).

The majority of surveys were conducted over a number of survey days from July to September 2017; with some smaller additional areas surveyed in May, June and July 2018. All NVC surveys were undertaken by MacArthur Green. In total 28 NVC communities were recorded within the respective study area along with various associated sub-communities, however only a small number of communities accounted for the majority of the NVC study area. The most common and widespread, making up the bulk of the NVC study area, are blanket bog and wet heath communities; specifically, M15 *Trichophorum germanicum – Erica tetralix* wet heath, M17 *Trichophorum germanicum – Eriophorum vaginatum* blanket mire and M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire. These communities also form many mosaics and transitional zones with a number of other less well represented mire and wet heath communities and contain a number of flushed communities, of which M10 *Carex dioica – Pinguicula vulgaris* mire is the most frequent. M32 *Philonotis fontana – Saxifraga stellaris* springs and rills are also present in parts of the NVC study area.

A number of dry heath communities are present over the steep slopes, summits, knolls and rocky plateaus within the NVC study area. The most common of these, due to the altitude of the NVC study area, are the wind clipped and prostrate montane *Calluna* heaths H13 *Calluna vulgaris – Cladonia arbuscula* heath and H14 *Calluna vulgaris – Racomitrium lanuginosum* heath.

The other main communities present are largely restricted to the highest summit and plateau areas, where stands of the montane grass/moss-heath communities U7 *Nardus stricta – Carex bigelowii* grass-heath and U10 *Carex bigelowii - Racomitrium lanuginosum* moss-heath are found. The largest expanse of these is on the top and ridge of Meall na h-Aisre. Patches of grassland are very rare within the NVC study area and are restricted to small pockets of typical upland unenclosed calcifugous grasslands. No mesotrophic or calcareous grassland communities were found.

The NVC surveys have also revealed the presence of a number of potential GWDTE habitats, as well as Annex I and Scottish Biodiversity List Priority Habitats.

The likelihood for GWDTE habitats to be dependent on groundwater, in this hydro-geological setting, has been reviewed. The vegetation communities in this environment are believed to be influenced by high levels of rainfall, low infiltration rates and low rates of evaporation. It is therefore considered unlikely that there are notable areas of groundwater fed habitats. Groundwater is assessed as being focussed to localised springs associated with the near surface weathered zone. The potential impact on localised groundwater flows paths has been discussed with SEPA through a series of pre-

application discussions (Annex E). Mitigation will be built into the design to maintain hydrological flow paths under tracks or via cut-off drains around non-linear infrastructure.

1 INTRODUCTION

MacArthur Green was commissioned by RES Ltd on behalf of Simec Wind One Ltd to carry out a National Vegetation Classification (NVC) and habitats survey at the proposed Glenshero Wind Farm site, near Newtonmore, Highland; (hereafter referred to as the 'the proposed development').

This report has been produced by MacArthur Green and in accordance with Scottish Natural Heritage (SNH) and Scottish Environmental Protection Agency (SEPA) guidelines. All staff contributing to this technical appendix have undergraduate and/or postgraduate degrees in relevant subjects, have deep professional ecological impact assessment and ecology survey experience, and hold professional membership of the Chartered Institute of Ecology and Environmental Management (CIEEM). The report has been reviewed and approved by David MacArthur of MacArthur Green and a copy of his CV is included in EIAR Volume 4: Technical Appendix 1.2.

The aim of the NVC survey is to identify and map the vegetation communities present within the NVC study area in order to identify those areas of greatest ecological interest (i.e. Annex I habitats[1]; potential Groundwater Dependent Terrestrial Ecosystems (GWDTE)[2]; and Scottish Biodiversity List (SBL) priority habitats).

This report details the findings of the NVC surveys together with an evaluation of those communities described.

2 THE SITE AND STUDY AREA

The proposed development is located approximately 13 km west of Newtonmore in the highlands, within part of the Glenshero Estate. The 'study area' in which NVC and habitat surveys were undertaken is shown in EIAR Volume 3: Figures 6.2 and 6.3. This study area is contained within the boundary of the site. The NVC study area covers an extensive area of upland and montane, open and treeless, habitat. The area is broadly characterised by a complex mix of summits, knolls and ridges of dry heath and montane communities, with transitional areas and wet heaths on slopes, giving way to areas of mainly blanket bog in basins. The site reaches an elevation of 862 metres above sea level at Meall na h-Aisre. The NVC study area contains a number of small standing waterbodies and is also dissected and drained by numerous small streams. The study area also links with the existing Stronelairg Wind Farm to the north. A small additional study area (for a gatehouse) is present distant to the north of the proposed development by the B862 road, near Fort Augustus.

3 METHODOLOGY

The vegetation was surveyed by a team of suitably qualified and experienced botanical surveyors using the NVC scheme (Rodwell, 1991-2000; 5 volumes) and in accordance with NVC survey guidelines (Rodwell, 2006). The NVC scheme provides a standardised system for classifying and mapping semi-natural habitats, and ensures that surveys are carried out to a consistent level of detail and accuracy.

[1] As defined by the Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora – the 'Habitats Directive'

[2] As defined within SEPA (2017). Guidance Note 31: Guidance on Assessing the Impacts of Windfarm Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems. Available for download from http://www.sepa.org.uk/media/143868/lupsgu31_planning_guidance_on_groundwater_abstractions.pdf.

Homogeneous stands and mosaics of vegetation were identified and mapped by eye, and drawn as polygons on high resolution aerial imagery field maps. These polygons were surveyed qualitatively to record dominant and constant species, sub-dominant species and other notable species present. The surveyors worked progressively across the NVC study area to ensure that no areas were missed and that mapping was accurate. NVC communities were attributed to the mapped polygons using surveyor experience and matching field data against published floristic tables (Rodwell, 1991-2000). Stands were classified to sub-community level where possible, although in many cases the vegetation was mapped to community level only because the vegetation was too species-poor or patches were too small to allow meaningful sub-community determination; or because some areas exhibited features or fine-scale patterns of two or more sub-communities.

Quadrat sampling was not used in this survey because experienced NVC surveyors do not necessarily need to record quadrats in order to reliably identify NVC communities and sub-communities (Rodwell, 2006). Notes were made about the structure and flora of larger areas of vegetation in many places (such as the abundance and frequency of species, and in some cases condition and evident anthropogenic impacts). It can be better to record several larger scale qualitative samples than one or two smaller quantitative samples; furthermore, qualitative information from several sample locations can be vital for understanding the dynamics and trends in local (study area) vegetation patterns (Rodwell, 2006).

Due to small scale vegetation and habitat variability and numerous zones of habitat transitional between similar NVC communities, many polygons represent complex mosaics of two or more NVC communities. Where polygons have been mapped as mosaics an approximate percentage cover of each NVC community within the polygon is given so that the dominant community and character of the vegetation could still be ascertained.

Botanical nomenclature in this report follows that of Stace (2010) for vascular plants and Atherton *et al* (2010) for bryophytes.

4 SURVEY CONSTRAINTS

The majority of the NVC survey was carried out on the following dates inclusive: 31st July – 3rd August, 21st – 24th August and 18th – 21 September 2017; during the optimal season for habitat surveys.

Further additional smaller areas associated with the proposed development were surveyed from 2nd - 4th May (following winter snow-melt), 26th – 27th June, and 2nd – 3rd July 2018. Despite the time of year of the May 2018 survey the vegetation was still recognisable and could be accurately attributed to an NVC community due to the surveyor knowledge of the NVC study area and persistent and still easily identifiable vegetation present such as various sub-shrubs, bryophytes etc.

Surveys were carried out by two/three surveyors, approximately between the hours of 0900 – 1800. Weather conditions were variable and mixed during the survey period, a number of days were amenable to survey; dry and bright, with broken cloud and relatively light to moderate winds. However, the micro-climate around the NVC study area frequently resulted in many days or periods with dense low-lying cloud that blanketed the higher ground within the NVC study area. This reduced visibility within making surveys difficult, and consequently surveys on some days were not

attempted or were abandoned; surveys were then rescheduled, and all habitat mapping was undertaken in good visibility. All parts of the NVC study area were accessible during the surveys.

The NVC system does not cover all possible semi-natural vegetation or habitat types that may be found. Since the NVC was adopted for use in Britain in the 1980s further survey work and an increased knowledge of vegetation communities has led to additional communities being described that do not fall within the NVC system. Where such communities are found and recorded they are given a non-NVC community code and are described.

It should be noted that the results from this survey, and the matches made in describing communities, represent a current community evaluation at the time of survey (as opposed to one seeking to describe what the community was before any human interference, or what it might become in the future). In light of this, a clear constraint of the vegetation survey and evaluation process as used in this and other surveys is that it offers only a snapshot of the vegetation communities present and should not be interpreted as a static long-term reference.

5 NVC SURVEY RESULTS AND VEGETATION DESCRIPTIONS

5.1 Summary of NVC Communities

The categories of vegetation within the NVC study area include the following 28 NVC communities recorded during the survey:

- Mires & flushes: M2, M3, M4, M6, M10, M17, M19, M20, M23;
- Wet heaths: M15, M16;
- Springs: M32;
- Dry & montane heaths: H9, H10, H12, H13, H14, H16, H21;
- Calcifugous grasslands, fern & montane communities: U4, U5, U6, U7, U10, U20;
- Swamp: S9; and,
- Woodland and Scrub: W7, W23.

The following sections describe the flora, structure and habitats of these communities and any associated observed sub-communities, as found within this study area. For each NVC community description, the first paragraph refers to the community in Britain or Scotland as a whole, before moving on to the other paragraphs which describe the vegetation as it was found to occur within this study area. The NVC communities within each broad habitat type (e.g. mires) are described in order of community number within the NVC study area.

The survey results are displayed in EIAR Volume 3: Figure 6.3. A number of target notes were also made during surveys, often to pinpoint areas or species of special interest. These target notes are shown in EIAR Volume 3: Figure 6.3 and detailed within Annex A, target note photographs are included within Annex B. Further photographs of a number of the typical habitat types found within the NVC study area are provided within Annex C.

5.2 Mires and Flushes

Given the size of the NVC study area, a relatively small number of mire types, and associated bog pools and flushes, are present, most often occupying flatter, wetter and gently sloping peaty areas. There are large expanses of blanket bog throughout the NVC study area, though the majority of these are severely hagged, degraded and actively eroding; consequently, there are large areas of

exposed bare peat, and in some areas the peat has eroded to the extent that the underlying rock and substrates are exposed. The communities present are described in further detail below.

5.2.1 M2 Sphagnum cuspidatum/fallax bog pool community

Communities/sub-communities recorded: M2

This community is typically found in pools and lawns on the surface of very wet and base-poor peats on ombrogenous and topogenous mires in the less oceanic parts of Britain (Rodwell *et al* 1991; Elkington *et al* 2001; Averis *et al* 2004). M2 is typically dominated by soft wet carpets of *Sphagnum cuspidatum* or *S. fallax*, or both. This community has been reduced by widespread drainage and cutting of mires, so that often just small and modified fragments remain within predominantly agricultural landscapes. However, this community also readily colonises shallow flooded workings (Rodwell *et al* 1991; Elkington *et al* 2001).

M2 is not widespread or extensive within the NVC study area and is only found in a few small pools or patches within some better stands of blanket bog and wet heath. It makes up a very small percentage of some mire mosaic areas. These areas of M2 tend to be dominated by *Sphagnum fallax* and *S. cuspidatum*. Throughout the carpet of Sphagna there are often scattered shoots of *Eriophorum angustifolium*.

5.2.2 M3 Eriophorum angustifolium bog pool community

The M3 community is typically found as small stands on barer exposures of acid peat in depressions, erosion channels or shallow peat cuttings on a wide range of mire types (Rodwell *et al* 1991; Elkington *et al* 2001). It can occur in permanently flooded pools and natural hollows on surfaces of more or less intact mires, and on dried-up hollows and among erosion features where the peat has been worn down in gullies or redistributed (Rodwell *et al* 1991; Elkington *et al* 2001; Averis *et al* 2004). The typical species, *Eriophorum angustifolium*, can occur as dense and often tall swards, but equally commonly it occurs as sparser shoots scattered over expanses of bare peat (Averis *et al* 2004).

M3 is very common throughout the NVC study area, and it often covers relatively large areas, or is a considerable proportion of blanket bog and wet heath mosaic areas. Rarely is the M3 within the study actually 'bog pool' habitat. The majority of M3 present consists of swards of *E. angustifolium* over an essentially bare peat substrate within the extensive erosion features present at the NVC study area, this community is mainly found in the eroding gullies and on the exposed sides and bases of peat haggs. The swards of *E. angustifolium* here vary from moderately dense to very sparse, with most stands tending to be quite open with much exposed peat amongst the shoots; in almost all cases *E. angustifolium* is the only species present.

M3 is also present over larger flatter areas of exposed and eroding peat and, in a few more isolated instances, it is found occupying some larger shallow flooded basins such as at Dubh Lochan east of Creag an Dearg Lochain. Here there is a quite dense sward of *E. angustifolium*, rarely with a few scattered associates, and the community grades in to an area of S9 *Carex rostrata* swamp (see section 5.7.1).

5.2.3 M4 Carex rostrata - Sphagnum fallax mire

The M4 community is characteristic of pools and seepage areas on peat soils of topogenous and soligenous mires where the waters are fairly acid and only slightly enriched. It can occur in bog pools

on the surface of basin mires, but is more common in obviously soligenous areas as in mire laggs and the wettest parts of water-tracks (Rodwell *et al* 1991; Elkington *et al* 2001). This mire typically has a cover of sedges over a carpet of semi-aquatic *Sphagnum* spp.

M4 is rare within the NVC study area and only five small stands were recorded. These areas are all dominated by *Carex rostrata*, associates are sparse but included *Carex nigra*, *C. echinata*, *C. viridula*, *Eriophorum angustifolium* and rarely *Trichophorum germanicum* and *Juncus squarrosus*. These species were underlain by a, sometimes patchy, layer of Sphagna dominated by *Sphagnum fallax*. One stand of M4 in the headwaters of the Allt Coire Iain Oig Burn grades into an area of S9 *Carex rostrata* swamp as the basal bryophyte layer is lost and replaced with shallow standing water.

5.2.4 M6 Carex echinata - Sphagnum fallax/denticulatum mire

Communities/sub-communities recorded: M6, M6a, M6b, M6c

This mire is the major soligenous community of peats and peaty gleys irrigated by base poor waters in the sub-montane zone of northern and western Britain. It typically occurs as small stands among other mire communities, grasslands and heaths, and is sometimes found with swamp and spring vegetation. It is commonly found in tracts of unenclosed pasture on upland fringes, particularly between 200m and 400m (although it may also be found much higher) and is ubiquitous in the upland fringes of Britain (Rodwell *et al* 1991; Elkington *et al* 2001). The M6 community has a distinct general character but includes a wide variation in species composition, expressed as four sub-communities. It is essentially a poor-fen with small sedges or rushes dominating over a carpet of oligotrophic and base-intolerant Sphagna (Rodwell *et al* 1991; Elkington *et al* 2001).

With much of the NVC study area being montane in nature, the presence of this more sub-montane flush community is quite limited considering the size of the NVC study area. It is infrequently scattered on some of the lower slopes and down the gullies of small watercourses within the NVC study area. It is present mostly as small flushes, runnels or soakways, and along and within occluding and minor watercourses.

Three of the four sub-communities were recorded within the NVC study area; M6a *Carex echinata* sub-community, M6b *Carex nigra* - *Nardus stricta* sub community and the M6c *Juncus effusus* sub-community. The most common types present are M6a and M6b, with only occasional small stands of M6c.

Vascular species recorded in varying frequency of occurrence and abundances within the NVC study area M6 mires included *Carex echinata*, *Carex nigra*, *C. panicea*, *C. viridula*, *Juncus effusus*, *J. squarrosus*, *Eriophorum angustifolium, Molinia caerulea*, *Trichophorum germanicum*, *Nardus stricta*, *Festuca vivipara*, *Agrostis* spp., *Anthoxanthum odoratum*, *Deschampsia flexuosa*, *Potentilla erecta*, *Galium palustre*, *Viola palustris*, *Dactylorhiza maculata* and *Narthecium ossifragum*. The most common and prevalent bryophytes were *Sphagnum fallax*, *S. palustre*, *S. capillifolium* and *Polytrichum commune*; however, others were occasionally present such as *Sphagnum papillosum*, *S. denticulatum* and *Hylocomium splendens*.

Stands of M6a and M6b within the NVC study area are typically dominated by *Eriophorum angustifolium* and the *Carex* spp. listed above over the community mosses; M6b being distinguished from M6a by a higher cover of *Carex nigra* and a higher abundance of grasses, particularly *Nardus*

stricta and *Juncus squarrosus*. Areas of M6c are easily recognised by the tall tussocks of *Juncus effusus*, these tend to be the most species-poor stands.

5.2.5 M10 Carex dioica - Pinguicula vulgaris mire

Communities/sub-communities recorded: M10, M10a

The M10 *Carex dioica – Pinguicula vulgaris* mire is a soligenous mire of mineral soils and shallow peats kept very wet by base-rich, calcareous and oligotrophic waters (Rodwell *et al* 1991; Elkington *et al* 2001). The community includes a range of distinctive calcicolous flush vegetation in which the bulk of the sward is composed of small sedges, dicotyledons and bryophytes. It is essentially a small sedge mire and is usually found in small stands. The community typically occurs in unenclosed uplands and most of the stands are grazed and trampled by large herbivores (Rodwell *et al* 1991; Elkington *et al* 2001). The community can occur wherever there is flushing with base-rich water, either below a springhead or where water emerges more diffusely from the ground, most stands being constantly irrigated (Averis *et al* 2004).

M10, and more specifically the M10a *Carex viridula - Juncus bulbosus/kochii* sub-community is found scattered across sloping sections of the NVC study area where underlying rocks are exposed the surface resulting in seepages and flushes. These M10 flushes are most often found over wet stony ground amongst patches of wet heath or eroded bog. As well as areas of more diffuse seepage there are a number of M10 flushes within the NVC study area that sit below, and are fed by, M32 *Philonotis fontana – Saxifraga stellaris* springheads (section 5.4.1). The M10 community accounts for a very small amount of the NVC study area, most stands are too small to map and are represented by a small percentage within mosaiced habitat areas or have been mapped as target notes (see Annex A). The highest density of M10 flushes is found on the western mid slopes and southern slopes of Meall na h-Aisre.

Many of the flushes are mostly made up of varying amounts of the characteristic small sedges *Carex dioica*, *C. viridula*, *C. panicea*, *C. hostiana* and *C. pulicaris* over typical bryophytes such as *Scorpidium* spp. Where the swards are a bit more diverse, commonly recorded associate species, generally indicating the M10a sub-community, included: *Pinguicula vulgaris*, *Narthecium ossifragum*, *Erica tetralix*, *Trichophorum germanicum*, *Drosera rotundifolia*, *Eriophorum angustifolium*, *Carex nigra*, *C. echinata*, *Viola palustris*, *Selaginella selaginoides* and the mosses *Sphagnum denticulatum*, *Calliergonella cuspidata* and *Racomitrium lanuginosum*.

These small soligenous mires are typically present as narrow flushes; this community is a GWDTE, due to its dependency on base-rich groundwater seepages.

5.2.6 M17 Trichophorum germanicum – Eriophorum vaginatum blanket mire

Communities/sub-communities recorded: M17, M17a, M17b, M17c

M17 *Trichophorum germanicum – Eriophorum vaginatum* blanket mire is the characteristic blanket bog vegetation of the more oceanic parts of Britain. It is typically found on deposits that are maintained in a permanently waterlogged state by a high and generally stagnant water-table (Rodwell *et al* 1991; Elkington *et al* 2001). It usually occurs on deeper peats, i.e. greater than 2m in depth over flat or gently sloping ground (Rodwell *et al* 1991). However, it can also occur extensively on shallower peat. This community is dominated by mixtures of monocotyledons, ericoid sub-shrubs and *Sphagnum* spp. It can occur as extensive, relatively uniform tracts, or as hummock and hollow

complexes, with this community giving way to bog pool vegetation in the hollows (Rodwell *et al* 1991; Elkington *et al* 2001).

M17 is common throughout the NVC study area and in many areas it forms large expanses of relatively homogenous, albeit degraded, bog. M17 is also abundant in many transitional zones between other types of blanket bog and wet heath vegetation and forms mosaics with these communities. All three sub-communities were recorded; the M17a *Drosera rotundifolia-Sphagnum* spp. sub-community, the M17b *Cladonia* sub-community and the M17c *Juncus squarrosus* - *Rhytidiadelphus loreus* sub-community. These sub-communities were also found to grade in and out of, or where juxtaposed with, each other in sections of the NVC study area.

The most striking aspect of the majority of blanket bog within the NVC study area is the degree to which it is actively eroding and degraded. Swathes of the landscape are characterised by large areas of severely hagged and eroding bog with localised peat re-distribution and areas of bare peat. In these areas much of the blanket bog vegetation is now restricted to the tops of the peat haggs, with hagg sides and the intervening erosion gullies consisting of either bare peat or colonised by the M3 *Eriophorum angustifolium* community (section 5.5.2). The deep peat present in a number of these areas can be easily seen through the depth of the erosion gullies and the height of the often-blocky peat haggs, which in some instances are up to 1.5-2m in height (photographic examples of this hagged bog are included within Annex C below). The erosion has been so severe in certain areas that the loss of peat from erosion gullies has exposed the underlying bedrock and granular substrates. In other areas peat pipes and collapsed peat pipes are evident and water can be seen and heard flowing under and through the peat.

This level and severity of peat hagging is uncommon within M17 mires as they tend to me more intact, wetter, and of better quality. In this region, peatlands in this state would usually more likely fall within the M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire community (section 5.2.7) owing to species compositions and the normal altitudinal ranges and geographical distribution of the respective communities (as discussed in Rodwell *et al* 1991). Indeed, some of it here does sit within M19, however subtle differences in the abundance of co-dominant species suggests much of the remaining vegetation on peat haggs has a closer affinity to M17, specifically the M17b *Cladonia* sub-community as discussed below. In many areas this hagged bog vegetation also lacks certain species that result in the classification of M17/M19 blanket bog communities, in these areas, despite the depth of peat evident, the vegetation that remains is much more referable to wet heath vegetation and as such some hagged areas include varying proportions of M15 *Trichophorum germanicum – Erica tetralix* wet heath (section 5.3.1) within mosaiced areas.

Among the bulkier vascular species present with the NVC study area M17, the most common are *Trichophorum germanicum*, *Calluna vulgaris, Eriophorum vaginatum* and *E. angustifolium*. The proportions of these, and the common associate species, often change between stands and sub-communities. Additional associates often recorded through various stands of M17 included: *Juncus squarrosus*, *Empetrum nigrum*, *Narthecium ossifragum*, *Erica tetralix*, *Vaccinium myrtillus*, *V. vitis-idaea*, *Potentilla erecta* and *Huperzia selago*. Many of these species can be locally abundant within the NVC study area, such as *E. nigrum*, whereas other were generally always of low cover, such as *E. tetralix*.

As indicated above all three M17 sub-communities are present within the NVC study area, however by far the most prevalent is the quite dry M17b *Cladonia* sub-community. M17b tends to occupy the areas of eroded blanket bog, the vegetation often only present on the tops of haggs. The areas of M17b within the NVC study area can be characterised by a clear co-dominance of *Trichophorum germanicum* and *Calluna vulgaris*, the proportions of these can change between stands but they tend to be the most conspicuous and dominant species, in some areas however the abundance of *T. germanicum* can outweigh all other species. Amongst these two species there is usually some tussocks of *Eriophorum vaginatum*, indicating a bog community as opposed to a wet heath community. *Eriophorum vaginatum* abundance is very variable in these stands, but it never becomes co-dominant or even abundant (as it does so in M19 mire – section 5.2.7) and is always of lower cover. It tends to be scattered and very patchy, and indeed is locally absent in some of the most severely eroded areas of bog. What also sets M17b apart from the other sub-communities here is the distinctive basal layer underneath the species mix described above. Uncharacteristically for a bog, there are few Sphagna in these areas of M17b, with *Sphagnum capillifolium* the most common species which is only found in small infrequent patches, many hagged areas contain no *Sphagnum* spp. Instead the basal layer is made up of an abundance of dominant *Cladonia* spp. (lichens) and lesser amounts of mosses, including; *Racomitrium lanuginosum*, *Rhytidiadelphus loreus*, *Pleurozium schreberi*, *Hylocomium splendens* and *Hypnum jutlandicum*.

Areas of M17a are much scarcer within the NVC study area and tend to be smaller patches of habitat. These stands are present where the bog remains intact, and wetter, with no peat hagging and where erosion is limited or not evident. These areas contain mixes of the same main community species as described above, however the biggest difference is in the basal layer where Sphagna are much more abundant and diverse, often forming small lawns in wet hollows. The proportion of pleurocarpous mosses here decreases, and *Cladonia* spp. effectively disappear. *Sphagnum capillifolium* is still the most common Sphagna in M17a, however other species commonly recorded included *S. papillosum*, *S. palustre*, *S. tenellum*, *S. fallax*, *S. denticulatum* and *S. compactum*. The largest area of M17a is found within a large basin area at the headwaters of the Allt Coire Iain Oig Burn, here the stand is dominated by *Trichophorum germanicum* and *Eriophorum angustifolium* with few sub-shrubs, and occasional *Eriophorum vaginatum*, but with extensive lawns of Sphagna.

A number of areas of M17c were also recorded in the NVC study area. In addition to the community constants, these areas are distinguished by a notable increase in *Juncus squarrosus* and *Vaccinium myrtillus* throughout the sward, and pleurocarpous mosses, particularly *Rhytidiadelphus loreus* and *Pleurozium schreberi*, characterise the basal layer rather than Sphagna (M17a) or *Cladonia* spp. (lichens) (M17b).

5.2.7 M19 Calluna vulgaris – Eriophorum vaginatum blanket mire

Communities/sub-communities recorded: M19, M19a, M19b, M19c

This is the typical blanket bog vegetation of high-altitude ombrogenous peats in the wet and cold climate of the uplands of northern Britain. In particular, it occurs on high-level plateaux and broad watersheds, usually above 300m, and is confined to deeper peats on flat or gently-sloping ground (Rodwell *et al* 1991; Elkington *et al* 2001). It is generally dominated by mixtures of *Eriophorum vaginatum* and ericoid sub-shrubs (especially *Calluna vulgaris*). *Sphagnum* spp. can be prominent over wetter ground but are not as luxuriant or rich as in most M17 mires (Rodwell *et al* 1991; Elkington *et al* 2001).

The character of the blanket bog and the erosion evident in the NVC study area has been described above (section 5.2.6). These features are also present within some areas of M19, however on the whole areas of M19 generally appear more intact. M19 is scattered throughout the NVC study area, and although some sizeable areas exist, it does not form stands as large as those seen for M17. M19 often forms mosaics and transitions with areas of M17 bog, and also M15 wet heath.

There is much overlap in the species assemblage of M19 and M17, however areas of M19 were distinguished from M17 largely on the proportions of a few characteristic species. As detailed above areas of M17 are dominated by *Trichophorum germanicum* and *Calluna vulgaris* with only patchy *Eriophorum vaginatum*, however areas of M19 in the NVC study area generally only have a small amount of *T. germanicum* and instead are characterised by a much higher abundance of *E. vaginatum*, which becomes co-dominant with the *Calluna* in what appears at a distance a 'greener' sward than the dull brown and ochre of M17 areas.

As well as *C. vulgaris*, *E. vaginatum* and sparse *T. germanicum*, these areas also contain varying amounts of *Eriophorum angustifolium, Juncus squarrosus*, *Empetrum nigrum*, *Narthecium ossifragum*, *Erica tetralix*, *Vaccinium myrtillus*, *V. vitis-idaea*, *Potentilla erecta*, *Deschampsia flexuosa*, *Carex nigra* and *Rubus chamaemorus*; occasionally some of these species are locally abundant. In a few areas there is also occasional *Betula nana* (see Annexes A and B).

Mosses are also abundant and the most prominent species include *Hylocomium splendens*, *Pleurozium schreberi*, *Hypnum* spp., *Rhytidiadelphus loreus, Racomitrium lanuginosum, Polytrichum commune* and *Aulacomnium palustre*. Patches of Sphagna are common, most tend to be of *Sphagnum capillifolium*, although *S. papillosum*, *S. palustre*, *S. compactum* and *S. fallax* are occasional. *Cladonia* spp. (lichens) also occur in drier patches of the basal layer.

All three M19 sub-communities were recorded within the NVC study area; the M19a *Erica tetralix* sub-community, M19b *Empetrum nigrum* sub-community and the M19c *Vaccinium vitis-idaea – Hylocomium splendens* sub-community. Differences between the sub-communities are often subtle in the field. Areas of M19a tending to have more *Erica tetralix* and *T. germanicum* than the other sub-communities in which these species are rare, conversely areas of M19b and M19c having more *Rubus chamaemorus*, *Vaccinium myrtillus*, *V. vitis-idaea* and occasional *Betula nana*, which are absent from areas of M19a. M19a was present in close association with some areas of M17, as this sub-community is the closest in character to M17 bog. However, overall, patchy and fragmented areas of the M19b and M19c sub-communities were more commonly found given the montane to sub-montane nature of these sub-communities and altitude of the NVC study area.

5.2.8 M20 Eriophorum vaginatum blanket mire

Communities/sub-communities recorded: M20

M20 *Eriophorum vaginatum* blanket mire is a community characteristic of ombrogenous peats on bogs where certain treatments have greatly affected the vegetation; grazing and burning have been of greatest significance, but drainage has also played a part in the development of M20 (Rodwell *et al* 1991; Elkington *et al* 2001). It is commonest on blanket mires where these factors have contributed both to floristic impoverishment and to erosion of the peats. The peats are generally drier than in M17 and most M19 bogs, often showing surface oxidation (Rodwell *et al* 1991; Elkington *et al* 2001).

M20 mire is rare within the NVC study area and is only found in a few isolated stands, often among areas of bare and eroding peat. The areas of M20 stand out from the other juxtaposed communities by lacking the sub-shrub element more common to the M17/M19 mires and M15/M16 wet heaths recorded in the NVC study area. The patches of M20 are dominated by tussocks of *Eriophorum vaginatum*, with only occasional tufts of *Deschampsia flexuosa* and *Festuca vivipara*. Some tussocks are carpeted in the mosses *Hylocomium splendens*, *Hypnum jutlandicum*, *Rhytidiadelphus loreus* and *Pleurozium schreberi*. Between the tussocks where the ground is sometimes wetter there is often *Polytrichum commune*, *Aulacomnium palustre*, *Sphagnum fallax*, *S. palustre* and *S. capillifolium*.

5.2.9 M23 Juncus effusus/acutiflorus – Galium palustre rush-pasture

Communities/sub-communities recorded: M23b

This rush-pasture is a community of gently-sloping ground in and around the margins of soligenous flushes, as a zone around topogenous mires and wet heaths, and in poorly drained, comparatively unimproved or reverted pasture. It can be found on a variety of moderately acid to neutral soils that are kept moist to wet for most of the year (Rodwell *et al* 1991; Elkington *et al* 2001). This vegetation is characterised by the abundance of either *Juncus effusus* or *J. acutiflorus* (sometimes both), with a ground layer of mesophytic herbs common in moist or permanently wet grasslands; associates are quite diverse. Acidophilous *Sphagna* and *Polytrichum commune* are rare in the M23 community (Averis *et al* 2004).

A small area of the M23b *Juncus effusus* sub-community was recorded around the section of the study area associated with the gatehouse. The vegetation here contains *Juncus effusus*, *Filipendula ulmaria*, *Lychnis flos-cuculi*, *Ranunculus repens*, *Holcus lanatus*, *Cirsium palustre*, *Viola palustris* and *Deschampsia cespitosa*.

5.3 Wet Heaths

5.3.1 M15 Trichophorum germanicum – Erica tetralix wet heath

Communities/sub-communities recorded: M15, M15a, M15b, M15c, M15d

This wet heath community is characteristic of moist and generally acid and oligotrophic peats and peaty mineral soils in the wetter western and northern parts of Britain. It is also associated with thinner or better drained areas of ombrogenous peat (Rodwell *et al* 1991; Elkington *et al* 2001). It is a vegetation type with few constant species and wide variation in its flora and dominant species. *Calluna vulgaris*, *Molinia caerulea*, *Trichophorum germanicum* and *Erica tetralix* are usually all of high frequency, and it is mixtures of these species that give the vegetation its general character. However sometimes one or two of them may be missing and their relative proportions can be very diverse (Rodwell *et al* 1991; Elkington *et al* 2001). M15 is generally an extremely variable community in terms of dominants, constants and co-dominants, which can vary markedly over short distances. Grazing and burning have important effects on the floristics and structure of this community, and draining and peat-cutting have extended its coverage to formerly deeper and wetter peats in which blanket mire communities (i.e. M17-M19) were initially present (Rodwell *et al* 1991; Elkington *et al* 2001).

M15 wet heath is very common and extensive across the NVC study area, it also forms large mosaic and transitional areas with blanket bog communities. M15 is present on both shallow peaty soils on sloping ground and on deeper peats where the former blanket bog has been degraded and the community floristics have shifted from bog to wet heath; these transitions are often subtle as the species assemblages are so similar, these mosaic/transitional zones are a feature of the NVC study area.

All fours sub-communities are present within the NVC study area: the M15a *Carex panicea* sub-community, M15b Typical sub-community, M15c *Cladonia* spp. sub-community and the M15d *Vaccinium myrtillus* sub-community. There is much cross over in the species present in each sub-community, however respective abundances of certain species, and other factors such as wetness, help to separate each one. The most abundant and extensive forms of M15 in the NVC study area are the M15c and M15d sub-communities, these variants are the driest sub-communities within the M15 continuum. Although less abundant there are also some sizeable areas of M15b, whereas M15a is the least common form and is generally restricted to wetter hollows or small areas of flushing.

Throughout the M15 in general, the main community co-dominants tend to be *Calluna vulgaris* and *Trichophorum germanicum*; *Eriophorum angustifolium* is also very common and locally abundant or co-dominant in places, and it is these main species that characterise the wet heath present. Of the other typical community associates, *Erica tetralix* is patchier and is absent in many stands but locally frequent in others; *Molinia caerulea* is very rare within the NVC study area.

Other species recorded in varying abundances, and sometimes locally abundant/frequent throughout areas of M15 included *Empetrum nigrum, Vaccinium myrtillus, Potentilla erecta, Juncus squarrosus* and *Narthecium ossifragum*. Species more occasional included *Vaccinium vitis-idaea, Erica cinerea, Carex binervis, C. panicea, C. nigra, C. echinata, C. pilulifera, Nardus stricta*, *Deschampsia flexuosa, Anthoxanthum odoratum, Festuca* spp*., Agrostis* spp*., Galium saxatile, Blechnum spicant*, *Huperzia selago* and *Polygala serpyllifolia*. Rarely there are sparse tussocks of *Eriophorum vaginatum*.

The basal layer underneath the vascular sward is variable and quite distinctive between a number of the sub-communities. Species recorded here include mixes of *Cladonia* spp. (lichens), *Racomitrium lanuginosum*, *Hypnum jutlandicum*, *Pleurozium schreberi*, *Hylocomium splendens*, *Dicranum scoparium*, *Rhytidiadelphus squarrosus*, *R. loreus*, *Polytrichum* spp. and *Aulacomnium palustre*. Sphagna are commonly present in the stands of M15a and M15b, most extensive is *Sphagnum capillifolium*, but also present are *S. fallax*, *S. palustre*, *S. tenellum* and rarely *S. papillosum*. Sphagna are much rarer, most often absent, in areas of M15c and M15d, and where present it is *S. capillifolium*.

As stated above, there is much overlap between the species present in the respective sub-communities, however some broad generalisations can be made with respect to the NVC study area, as per below.

M15a is more of a flushed wet heath on sloping ground and contains many of the species already listed. However, in these stands the shrubby component is a bit sparser due to the increased wetness, with *Calluna vulgaris* only occasional here. Instead there is much more *Trichophorum germanicum* and *Eriophorum angustifolium* and small sedges such as *Carex panicea* and *C. echinata*; *Pinguicula vulgaris* was also recorded is some M15a flushes. The areas of M15b are rather diverse in

their species assemblages and do not fit within the other better defined sub-communities, these areas contain the main community species as per above, with often a more conspicuous layer of *Sphagnum* spp. The M15c sub-community is apparent through the lack or absence of Sphagna in the basal layer, the ground instead generally carpeted by dominant *Cladonia* spp. and/or *Racomitrium lanuginosum*. Areas of M15d were heavily dominated by *Trichophorum germanicum* and also included *Vaccinium myrtillus*, *Juncus squarrosus* and a number of calcifuge graminoids, Sphagna was also rare in this sub-community.

5.3.2 M16 Erica tetralix – Sphagnum compactum wet heath

Communities/sub-communities recorded: M16d

This wet heath community is found on acid and oligotrophic mineral soils or shallow peats that are moist and at least seasonally waterlogged; it can, more rarely, also be found on the thin margins of blanket bogs. M16 typically occurs on sloping ground, although it can cover almost level ground too. In Scotland it extends onto thin ombrogenous peats at higher altitudes. Grazing and burning are important in maintaining the vegetation (Rodwell *et al* 1991; Elkington *et al* 2001). This community is characteristically dominated by mixtures of *Erica tetralix*, *Calluna vulgaris*, *Trichophorum germanicum* and *Molinia caerulea*, but their proportions are very variable, being influenced by differences in the water regime and trophic state of the soils, and also by grazing and burning.

M16 is scattered throughout the NVC study area, though it never forms large stands and tends to found in small scattered fragments of habitat. All areas were of the M16d *Juncus squarrosus* - *Dicranum scoparium* sub-community, which is the most common form in Scotland. It is found in the more elevated areas of ground on moderately steep to flatter slopes over thin and damp, often stony or rocky peats/wet peaty soils where the rocky substrate is quite often exposed in places. The site-specific occurrence of M16 within the NVC study area follows a very consistent pattern throughout. It generally can be seen bridging many intervening gaps on the slopes between the dry and montane dry heaths on the rocky knolls and ridges upslope through to the deeper peats of areas of degraded blanket bog in the flatter areas and basins below. This sloping wet heath zone, more often than not, also contains the commoner and more prevalent in Scotland M15 form of wet heath (described above), and in which M16d often forms mosaics and is difficult to separate transitions with. In this upland Scottish context, these two wet heath types are very similar and differences between them are often subtle and difficult to define or discern in the field.

M16d is the usual form of this heath in Scotland and it is notably different from the other sub-communities in the comparative frequency and abundance of the defining species. M16d is the driest form of this heath type, as Sphagna become sparse and patchy and are instead replaced with a higher abundance of non-*Sphagnum* mosses and, in particular, lichens. The dryness of M16d is also reflected in the relative abundances of the main vascular species, most notably the decrease in the damper conditions favouring *Erica tetralix* and the increase in *Calluna* abundance and vigour. Stands of M16d in Scotland also commonly contain some *Eriophorum angustifolium*, *Narthecium ossifragum* and *Potentilla erecta*. The presence of these particular additional species and their increased frequency in M16d is a feature of the floristic shift and transitions from M16d to M15 *Trichophorum germanicum – Erica tetralix* wet heath observed in moving into the uplands. Such transitions are frequent, particularly on wet slopes with moderately thick ombrogenous peat.

The character of the areas of M16d are fairly consistent throughout the NVC study area, with a species-poor sward which is defined and generally characterised by co-dominant mixtures of *Calluna vulgaris* and *Trichophorum germanicum* with abundant and sometimes locally dominant *Juncus squarrosus* and *Eriophorum angustifolium*. In most areas there were few other vascular species, though *Empetrum nigrum* was frequent. Much more rarely, and only in some stands, were records for *Carex panicea*, *Molinia caerulea*, *Vaccinium myrtillus* and *Huperzia selago* and given the altitude of the NVC study area, some stands also contained sparse *Carex bigelowii*. *Erica tetralix* was very rare, and for the most part absent.

The basal layer of the NVC study area stands are dominated by *Cladonia* spp. (lichens) and *Racomitrium lanuginosum*, with some pleurocarpous mosses such as *Pleurozium schreberi*. Sphagna are rare and patchy, and actually absent from most stands. Where present it tends to be *Sphagnum capillifolium* rather than *S. compactum* or *S. tenellum* as would be expected in M16 (as *S. capillifolium* is usually more indicative of M15); however, small patches of *S. compactum* were noted in some areas. The reasons for assigning these areas as M16d instead of M15 are discussed further below.

On occasions *Trichophorum germanicum* was the single main dominant species in the sward in these stands; this is a common occurrence in many upland heaths and results from the legacy of a long grazing history (by deer in this case) as more palatable species are grazed out to leave *T. germanicum*. In these *T. germanicum* heaths the other typical species such as *Calluna* are much reduced and sparse; other associated species tend to be present in small quantities. As has been discussed by Averis & Averis[3] this is essentially a non-NVC vegetation type as the dominance of *T. germanicum* can be confusing with regard to NVC classification, but the vegetation is in '*most cases*' referable to M15 (classifiable at community level or even specifically as sub-communities M15b, M15c or M15d depending on the associated species). However, where *Potentilla erecta* and/or *Sphagnum capillifolium* are very rare or absent and the vegetation noticeably species-poor, then M16 is considered a better fit; specifically, M16d is the closest fit community.

Given the information above on the species assemblage and floristics within areas mapped as M16d and the character of wet heath communities from the literature, it was considered that these species-poor stands characterised by *Calluna*, *T. germanicum*, *Juncus squarrosus* and frequent *Eriophorum angustifolium* with few other species (noting absent or rare *Potentilla erecta*) along with a dry basal layer of lichens and *Racomitrium lanuginosum* and absent to rare patches of Sphagna were more appropriately classified as M16d rather than M15 (as per Averis & Averis[3]).

5.4 Springs

5.4.1 M32 Philonotis fontana – Saxifraga stellaris spring

Communities/sub-communities recorded: M32a

M32 is a community of springs and rills at moderate to high altitudes, mainly from 450m to over 1000m, where there is irrigation with circumneutral and oligotrophic waters. This is one of the most common and widespread types of spring vegetation in the uplands of north-west Britain and is dependent on sustained and vigorous irrigation by groundwater (Rodwell *et al* 1991; Elkington *et al*

[3]Non-NVC vegetation types found by Ben and Alison Averis (09-09-2015).doc
http://www.benandalisonaveris.co.uk/downloads_13.html

2001). The community is common throughout the Scottish Highlands. These bryophyte-dominated springs, flushes and rills are striking in appearance; *Philonotis fontana* is often dominant and visually obvious by its bright green colour.

A number of M32 springs and rills, all of the M32a *Sphagnum denticulatum* sub-community, are present within the NVC study area (see Annex A and EIAR Volume 3: Figure 6.3). These springs are dominated by mounds and mats of *Sphagnum denticulatum*, and in some cases there is little else present. Where some associate species are present the following were recorded: *Philonotis fontana, Polytrichum commune, Dichodontium palustre,* small *Carex* spp. and *Festuca vivipara*.

Many of the M32 springs present grade into M10 *Carex dioica* - *Pinguicula vulgaris* flushes below (section 5.2.5). M32 is also a GWDTE community as it relies on irrigation by groundwater.

5.5 Dry & Montane Heaths

5.5.1 H9 Calluna vulgaris – Deschampsia flexuosa heath

Communities/sub-communities recorded: H9

This heath is a characteristic sub-shrub vegetation of acid and impoverished soils at low to moderate altitudes. It is normally found on very base-poor soils, highly oligotrophic and at least moderately free-draining, often excessively so, which have been derived from a wide variety of parent materials (Rodwell *et al* 1991; Elkington *et al* 2001). *Calluna vulgaris* is typically the most abundant plant in this community and no other sub-shrubs are consistently frequent throughout, although some can be locally abundant. The only other vascular constant is *Deschampsia flexuosa* (Rodwell *et al* 1991; Elkington *et al* 2001).

A small area of H9 was recorded around the section of the study area associated with the gatehouse. The vegetation here contains dominant *Calluna* along with some sparse *Deschampsia flexuosa, Molinia caerulea* and *Nardus stricta*.

5.5.2 H10 Calluna vulgaris – Erica cinerea heath

Communities/sub-communities recorded: H10b

H10 *Calluna vulgaris – Erica cinerea* heath is a dry heath community that occurs widely throughout the more oceanic sections of Scotland and around the east-central part of the Highlands. It is a community characteristic of acid to circumneutral and generally free-draining soils and is typically dominated by *Calluna vulgaris*. *Erica cinerea*, a constant, is frequent but generally subordinate to *C. vulgaris*. H10 is commonly found in zonations and mosaics with grasslands, other heath types and mire communities (Rodwell *et al* 1991; Elkington *et al* 2001).

Only a single small stand of H10 heath was recorded within the NVC study area, this was a stand of the H10b *Racomitrium lanuginosum* sub-community in the eastern study area on a steep bank. The stand was a co-dominant mixture of *Calluna vulgaris* and *Erica cinerea.* Throughout these two species there were lesser and scattered amounts of associates, some very typical to this sub-community, including *Potentilla erecta*, *Vaccinium myrtillus*, *Trichophorum germanicum* and *Empetrum nigrum* over a carpet of *Racomitrium lanuginosum* and *Cladonia* spp. (lichens).

5.5.3 H12 Calluna vulgaris – Vaccinium myrtillus heath

Communities/sub-communities recorded: H12, H12a, H12b

H12 *Calluna vulgaris – Vaccinium myrtillus* heath is a typical sub-shrub community of acidic to circumneutral, free-draining mineral soils throughout the cold and wet sub-montane zone, generally between 200m and 600m. H12 is generally dominated by *Calluna vulgaris* although the cover of this species can be open and degenerate. *Vaccinium myrtillus* is constant, though it is usually subordinate to *C. vulgaris*. The ground layer is generally characterised by bulky mosses (Rodwell *et al* 1991; Elkington *et al* 2001). H12 heaths are rather uniform and they cover extensive areas throughout large parts of Scotland.

H12 heath is patchily scattered throughout the NVC study area, it never forms extensive stands, tending to be found in smaller patches on slopes or knolls/summits at lower altitudes within the NVC study area; the community being replaced at higher elevations by H13 and H14 montane heaths as described below.

Within the NVC study area the H12 vegetation consists of dense canopies of *Calluna* with shoots of *Vaccinium myrtillus* and/or *V. vitis-idaea* where the former is not overly dominant. Herbs are usually inconspicuous below the canopy, and there is usually a dense carpet of pleurocarpous mosses including *Hylocomium splendens*, *Hypnum jutlandicum, Pleurozium schreberi*, *Rhytidiadelphus triquetrus* and *R. loreus*. In places there are also *Cladonia* spp. (lichens).

Two of the three sub-communities were recorded in the NVC study area, most stands are of the H12a *Calluna vulgaris* sub-community but there are patches of the H12b *Vaccinium vitis-idaea – Cladonia portentosa* sub-community also.

The vegetation of a considerable proportion of H12a consists of little more than *Calluna vulgaris* over a lawn of pleurocarpous mosses with a few sprigs of *Vaccinium myrtillus* interleaved through the canopy (and it can be locally absent). In some cases, *V. myrtillus* does thicken up and is more noticeable in the sward. Other typical associates in lower but very variable abundances in H12a within the NVC study area include *Erica cinerea*, *Empetrum nigrum, Arctostaphylos uva-ursi, Deschampsia flexuosa*, *Festuca ovina*, *F. vivipara*, *Agrostis capillaris*, *Nardus stricta*, *Juncus squarrosus*, *Potentilla erecta, Galium saxatile*, *Luzula* spp. and *Carex binervis*. Stands of H12b contain many of the species listed above but are distinguished by a noticeable abundance of *Vaccinium vitis-idaea*, which defines this sub-community.

5.5.4 H13 Calluna vulgaris – Cladonia arbuscula heath

Communities/sub-communities recorded: H13, H13a, H13b

H13 is the characteristic sub-shrub vegetation of base-poor soils, over exposed ridges and summits of mountains, in parts of Britain with a cold continental climate. It is most widespread through the east-central Highlands of Scotland. It is a vegetation type of unsheltered slopes generally between 600m and 900m where there are almost constant strong winds (Rodwell *et al* 1991; Elkington *et al* 2001). This heath has a dwarfed mat of sub-shrubs with few vascular associates, but with a prominent lichen flora. *Calluna vulgaris* is the most frequent species, generally prostrate and forming a carpet. Among other sub-shrubs *Empetrum nigrum* is most important, and *Vaccinium myrtillus* and *V. vitis-idaea* are common, but always subordinate in cover (Rodwell *et al* 1991; Elkington *et al* 2001).

Stands of H13, and mainly the H13b *Empetrum nigrum - Flavocetraria nivalis* sub-community, are commonplace throughout the NVC study area on the wind-clipped and exposed tops and ridges in the highest parts of the NVC study area. Here, the community forms numerous small patches and stands on very thin exposed and rocky soils and knolls amongst the wider expanses of wet heath and blanket bog.

The vegetation is quite homogeneous throughout the NVC study area and is characterised by a co-dominance of a mat of dwarfed and prostrate *Calluna* over *Cladonia* spp. lichens. Of the associate species *Empetrum nigrum* is also very abundant and co-dominant in some stands. Other species more frequently to occasionally recorded included *Trichophorum germanicum*, *Vaccinium myrtillus, V. vitis-idaea*, *Carex bigelowii*, *Diphasiastrum alpinum*, *Huperzia selago* and *Euphrasia* sp. *Racomitrium lanuginosum* is also common in the basal layer in some stands, but in H13 it is always subordinate to the lichens (cf. H14 below).

5.5.5 H14 Calluna vulgaris – Racomitrium lanuginosum heath

Communities/sub-communities recorded: H14, H14b

H14 is the typical sub-shrub community of base-poor soils on windswept plateaux and ridges at moderate to quite high altitudes in the cool oceanic climate of the mountains of north-west Scotland; usually found up to 750m in altitude (Rodwell *et al* 1991; Elkington *et al* 2001). It is found over gentle to moderately steep slopes which are exposed to fairly constant strong winds. This heath consists essentially of a dwarfed sub-shrub mat with *Calluna vulgaris* usually predominant, together with *Racomitrium lanuginosum*; other sub-shrubs play a subordinate role, most frequent is *Empetrum nigrum* (Rodwell *et al* 1991; Elkington *et al* 2001).

Stands of H14, and the H14b *Empetrum nigrum* sub-community, are commonplace throughout the NVC study area on the wind-clipped and exposed tops, ridges and slopes in the higher parts of the NVC study area. Here, the community forms numerous patches and stands on thin exposed and rocky soils and knolls amongst the wider expanses of wet heath and blanket bog.

The vegetation of H14 within the NVC study area is very similar to that as described above for H13 heath, with a dwarfed mat of prostrate *Calluna* and very abundant *Empetrum nigrum.* The point of distinction between the two communities being based upon the basal layer; here in H14 the ground is carpeted in a dense mat of *Racomitrium lanuginosum*, as opposed to the crust of lichens in H13. Vascular associates in H14 in the NVC study area share many species with H13 and included records of the following in varying but lesser abundances; *Trichophorum germanicum*, *Vaccinium myrtillus, V. vitis-idaea*, *Carex bigelowii*, *Erica cinerea*, *Deschampsia flexuosa, Nardus stricta, Festuca vivipara, Juncus squarrosus*, *Diphasiastrum alpinum* and *Huperzia selago*. As indicated above the basal layer is overwhelmingly dominated by *Racomitrium lanuginosum*, however there are sometimes patches of scattered *Polytrichum* sp., *Pleurozium schreberi*, *Hypnum* sp., *Rhytidiadelphus loreus*, *Dicranum scoparium* and lichen species.

5.5.6 H16 Calluna vulgaris – Arctostaphylos uva-ursi heath

Communities/sub-communities recorded: H16, H16c

H16 *Calluna vulgaris – Arctostaphylos uva-ursi* heath is a typical sub-shrub community of circumneutral to base-poor soils at moderate altitudes, and is generally found between 240m and 600m altitude in the cold continental climate of the east-central Highlands, with especially good representation around Speyside (Rodwell *et al* 1991; Elkington *et al* 2001). H16 is characterised by the relative abundance of *A. uva-ursi* alongside typical heath vegetation including *C. vulgaris*, and in lower abundances *Erica cinerea* (Elkington *et al* 2001).

Only two small stands of H16 were noted within the NVC study area, one of which was attributed to the H16c *Cladonia* spp. sub-community. These stands contained fairly cropped *Calluna* due to altitude with abundant *Arctostaphylos uva-ursi* and *Empetrum nigrum*. Also present in the sward were *Vaccinium myrtillus, Carex bigelowii* and *Festuca vivipara* over a number of pleurocarpous mosses and *Cladonia* spp. (lichens).

5.5.7 H21 - Calluna vulgaris – Vaccinium myrtillus – Sphagnum capillifolium heath

Communities/sub-communities recorded: H21a

The H21 community generally has a mixed canopy of sub-shrubs, usually 30-50cm high, with a damp layer of luxuriant bryophytes. *Calluna vulgaris* is usually the dominant ericoid, although *Vaccinium myrtillus* can also be common. Bryophytes form an extensive and lush carpet; particularly distinctive is the high frequency and local abundance of *Sphagnum capillifolium* (Rodwell *et al* 1991; Elkington *et al* 2001). This heath is highly characteristic of fragmentary humic soils in situations with a cool but equable climate and a consistently shady and humid atmosphere. It is widespread at low to moderate altitudes in upland Britain. It is found mainly on steep, shady slopes of north-west to easterly aspect, often with rock outcrops (Rodwell *et al* 1991; Elkington *et al* 2001).

A small number of small stands of H21, specifically the H21a *Calluna vulgaris - Pteridium aquilinum* sub-community were recorded in the NVC study area. These were found on steep slopes lower down, most often in shaded watercourse gullies/banks. The community is picked out from surrounding communities in the NVC study area by an obvious layer of red-green *Sphagnum capillifolium* beneath a canopy of *Calluna* interleaved with *Vaccinium myrtillus* and *V. vitis-idaea*. Also present to a lesser degree in the sward are *Empetrum nigrum*, *Blechnum spicant, Galium saxatile, Festuca vivipara, Agrostis capillaris, Deschampsia flexuosa* and *Euphrasia* sp. As well as *S. capillifolium* in the basal layer there are also patches of *Rhytidiadelphus loreus, Pleurozium schreberi, Hylocomium splendens, Racomitrium lanuginosum, Polytrichum* sp. and *Cladonia* spp. (lichens).

5.6 Calcifugous Grasslands, Fern & Montane Communities

5.6.1 U4 Festuca ovina – Agrostis capillaris – Galium saxatile grassland

Communities/sub-communities recorded: U4, U4a, U4d, U4e

The U4 *Festuca ovina - Agrostis capillaris - Galium saxatile* grassland is a form of predominately upland grassland of well-drained, acidic and base-poor mineral soils throughout the wet and cool regions of north-west Britain where it dominates extensive areas of pastureland (Rodwell *et al* 1992; Cooper 1997). Throughout this geographic range the community can often be found forming a distinctive component of larger mosaics of grasslands, heaths, and mires.

U4 is very sparse throughout the NVC study area, it does not form large areas of upland pasture, but instead is present as small pockets of unenclosed grassland amongst other upland heath and mire

communities. Three of the five recognised sub-communities were noted in the NVC study area, unsurprisingly these include the more characteristically upland variants of the community (e.g. U4e). The sub-communities recorded were U4a Typical sub-community, U4d *Luzula multiflora* - *Rhytidiadelphus loreus* sub-community and the U4e *Vaccinium myrtillus – Deschampsia flexuosa* sub-community.

Areas of U4 grassland in the NVC study area are identified on the presence of a grass-rich sward dominated by various combinations of *Agrostis capillaris*, *Festuca ovina*, *F. vivipara* and *Anthoxanthum odoratum*, with *Galium saxatile* and *Potentilla erecta* consistent associates. A well-developed moss layer is also characteristic, generally dominated by *Rhytidiadelphus squarrosus* with frequent *Pleurozium schreberi* and in places *Hylocomium splendens* also. Typical quantities of these species, and associate species, differ between the respective sub-communities. Other species recorded in the areas of U4, abundances of which define some of the sub-communities, included *Nardus stricta*, *Vaccinium myrtillus, Luzula multiflora, Agrostis canina, Deschampsia flexuosa, Carex nigra, Molinia caerulea, Rumex acetosa, Viola riviniana, Juncus squarrosus* and *Calluna vulgaris.*

5.6.2 U5 Nardus stricta – Galium saxatile grassland

Communities/sub-communities recorded: U5, U5a, U5b, U5d, U5e

U5 grassland tends to be found on damp mineral soils which have peaty upper horizons. U5 typically occupies slopes where the depth and wetness of the soil are intermediate between those of the drier podsols under U4 grasslands and wet shallow peats found under U6 grassland. The underlying rock can be anything from acid to basic, but the soils are generally acidic (Rodwell *et al* 1992; Averis *et al* 2004). U5 is common on the higher hill slopes of the cool, wet north and west of Britain (Rodwell *et al* 1992; Cooper, 1997). It is also commonly found on well-drained but moist alluvial soil along the margins of streams (Averis *et al* 2004).

The sward of the U5 community is dominated by *Nardus stricta* in association with the same main community species as listed above for U4, albeit at a lower cover. The prominence of *N. stricta* defines U5 and the associated flora defines the sub-communities. U5 is scattered in small patches throughout the NVC study area, and it does not form large extensive stands. Four out of five sub-communities were recorded in the NVC study area: The U5a Species-poor sub-community, U5b *Agrostis canina – Polytrichum commune* sub-community, U5d *Calluna vulgaris – Danthonia decumbens* sub-community and the U5e *Racomitrium lanuginosum* sub-community.

The areas of U5a are typically dominated by *Nardus stricta* with a sparse interleaving of a few common associates as per the U4 community, over a thick carpet of mainly pleurocarpous mosses. Areas of the most upland and heathy variants, U5d and U5e, are most often found in the more elevated parts of the NVC study area, where the U5 *Nardus stricta* sward often transitions into U7 *Nardus stricta – Carex bigelowii* grass-heath or gives way to H13 or H14 montane heaths. These areas of U5d and U5e frequently contain patches of *Deschampsia flexuosa*, *Vaccinium myrtillus, V. vitis-idaea, Empetrum nigrum, Trichophorum germanicum, Calluna vulgaris, Molinia caerulea, Carex bigelowii* and *Juncus squarrosus*.

Mosses such as *Hypnum jutlandicum, Hylocomium splendens*, *Rhytidiadelphus squarrosus*, *R. loreus* and *Pleurozium schreberi* are common throughout all the sub-communities; however, *Polytrichum*

commune is abundant in U5b and *Racomitrium lanuginosum* is prominent in U5e, helping to distinguish these sub-communities.

5.6.3 U6 Juncus squarrosus – Festuca ovina grassland

Communities/sub-communities recorded: U6, U6a, U6c, U6d

U6 *Juncus squarrosus* - *Festuca ovina* grassland is characteristic of moist peats and peaty mineral soils, almost always base-poor and infertile, over gentle slopes and plateaux at higher altitudes (400m to 800m) in the cool and wet north and west of Britain (Rodwell *et al* 1992; Cooper, 1997). U6 is often a secondary vegetation type, strongly encouraged by particular kinds of grazing and burning treatments in damper upland pastures and on the drying fringes of blanket mires. The spread of *J. squarrosus* in upland pastures tends to be encouraged where uncontrolled heavy and selective grazing has been applied over rather ill-drained ground (Rodwell *et al* 1992; Cooper, 1997).

Patches of U6 are infrequently scattered throughout the NVC study area, and they are all of small relative size. Three sub-communities were recorded; the U6a *Sphagnum* sub-community, U6c *Vaccinium myrtillus* sub-community and the U6d *Agrostis capillaris – Luzula multiflora* sub-community. As would be expected *Juncus squarrosus* is the dominant species in each stand, however a number of associates common to upland grasslands are also present in lesser amounts, such as *Festuca* spp., *Deschampsia flexuosa, Nardus stricta* and *Agrostis* spp.

Areas of U6a were the wettest and present on damp peat, or in flushed areas, often in mosaics with or in close association with M6 flushes or flushed M15a wet heath. Throughout the *J. squarrosus* of U6a the most apparent feature is the amount of Sphagna, with abundant *Sphagnum capillifolium*, *S. palustre* and *S. fallax*, also more common in U6a were *Eriophorum angustifolium, Carex nigra* and the mosses *Polytrichum commune* and *Aulacomnium palustre*.

U6d is the most grass-rich variant and in the NVC study area *J. squarrosus* is frequently accompanied by *Agrostis capillaris*, *Deschampsia flexuosa, Nardus stricta, Festuca vivipara, F. ovina, Anthoxanthum odoratum, Viola riviniana, Polygala serpyllifolia, Luzula multiflora*, *Galium saxatile, Carex binervis* and *Potentilla erecta.*

U6c tends to be the most species-poor variant in the NVC study area, the sward of *J. squarrosus* is interleaved with sparse graminoids as per above and some sprigs of *Vaccinium myrtillus* over a number of bulky typical pleurocarpous moss species.

5.6.4 U7 Nardus stricta – Carex bigelowii grass-heath

Communities/sub-communities recorded: U7

Nardus stricta – Carex bigelowii grass-heath is a community of snow-bound slopes at higher altitudes in the cold and wet uplands of northern Britain in peaty-mineral soils. U7 is for the most part confined to the mountains of the Scottish Highlands in the low-alpine zone and above, most common from 600m to 900m in altitude, but sometimes up to 1200m and above (Rodwell *et al* 1992; Cooper, 1997). In U7 *Nardus stricta* is generally the dominant plant, with varying amounts of *Carex bigelowii* and *Racomitrium lanuginosum*; though the sward can appear quite varied due the local frequency and abundance of a range of associates. The sward is short, usually only around a decimetre tall, and can vary from grassy swards, through heathy vegetation, to stands with extensive mossy carpets (Rodwell *et al* 1992; Cooper, 1997).

Patches of U7 are scattered through the most elevated parts of the NVC study area, and it is quite extensive around the summit and upper slopes of Meall na h-Aisre. The vegetation is short and is easily apparent by a sward of abundant *Nardus stricta* and *Carex bigelowii* over carpets of *Racomitrium lanuginosum*. There are a number of associated species scattered throughout this characteristic sward, all more frequent to occasional, although some species can be very locally abundant also. The main associates recorded in the NVC study area included a scattering of *Deschampsia flexuosa*, *Vaccinium myrtillus, Huperzia selago, Diphasiastrum alpinum, Empetrum nigrum, Juncus squarrosus, Trichophorum germanicum, Festuca ovina/vivipara, Galium saxatile* and, rarely, prostrate *Calluna vulgaris*. As well as *Racomitrium lanuginosum* carpeting the ground there is often some smaller patches of *Polytrichum* spp., *Dicranum* spp. and *Cladonia* spp. (lichens).

5.6.5 U10 Carex bigelowii - Racomitrium lanuginosum moss-heath

Communities/sub-communities recorded: U10, U10b

Carex bigelowii - *Racomitrium lanuginosum* moss-heath is characteristic of wind-swept, cloudy plateaus at moderate to very high altitudes through the cold and humid mountains of north-west Britain; it is a community of low to middle alpine zones, mostly above 750m in altitude (Rodwell *et al* 1992; Cooper, 1997). This moss-heath takes in both continuous carpets of mossy heath and more open vegetation in which *Racomitrium lanuginosum* remains an important distinguishing feature. In closed swards this moss is overwhelmingly dominant in an extensive almost total cover of densely packed shoots in a mat up to 5cm thick, in other areas there can be a gradation through to broken rocky ground with more patchy carpets of *Racomitrium lanuginosum*. Vascular species are few and scattered (Rodwell *et al* 1992; Cooper, 1997).

U10, specifically the U10b Typical sub-community, is present in the NVC study area in one main area (although a few very minor stands occur on other summit tops locally). The main locus for U10 in the NVC study area is around the summit of Meall na h-Aisre and its associated plateau and small ridge to the north-east. In this area of U10b, the vegetation consists of a tight ubiquitous carpet of *Racomitrium lanuginosum* which is interspersed with scattered and occasional shoots of *Carex bigelowii*. Also noted as rarely present within this community in the NVC study area were *Vaccinium myrtillus, Deschampsia flexuosa, Empetrum nigrum, Festuca ovina/vivipara* and *Nardus stricta*. The basal layer also rarely contains patches of *Rhytidiadelphus loreus*, *Dicranum* sp. and *Cladonia* spp. (lichens).

5.6.6 U20 Pteridium aquilinum – Galium saxatile community

Communities/sub-communities recorded: U20

The U20 *Pteridium aquilinum – Galium saxatile* community is vegetation dominated by *Pteridium aquilinum*, which can form extensive stands. The community is most common on lower hill slopes and on marginal ground, including abandoned fields, where it forms mosaics and transitions with heaths, grasslands and woodlands. The community covers fairly deep, well aerated but often moist, base-poor and infertile soils (Rodwell *et al* 1992; Cooper, 1997). It is largely absent from wet ground and strongly flushed slopes. *Pteridium aquilinum* is the sole dominant and is overwhelmingly abundant in some stands. This is a community of little ecological value. Some small patches of U20 were recorded within the section of the study area associated with the gatehouse.

5.7 Swamps

5.7.1 S9 Carex rostrata swamp

Communities/sub-communities recorded: S9, S9a

S9 swamp is generally a community of the north and west of Britain. The vegetation is typically a swamp of shallow to moderately deep, mesotrophic to oligotrophic standing waters with organic substrates. It also occurs more fragmentarily in peat cuttings (Rodwell *et al* 1995). The S9 community is readily recognised by the tall, dense growth of *Carex rostrata* rooted in shallow water. Separation from other communities in which *C. rostrata* is present is based on its almost exclusive dominance in this community and the low cover and richness of associates.

S9 is rare within the NVC study area and was only recorded in three stands, two of which are small. The most notable stand is a sward of *Carex rostrata* in shallow peaty water in the basin of Dubh Lochan, east of Creag an Dearg Lochain.

5.8 Woodland & Scrub

5.8.1 W7 Alnus glutinosa – Fraxinus excelsior – Lysimachia nemoreum woodland

Communities/sub-communities recorded: W7

W7 is typical of moist to very wet mineral soils which are only moderately base-rich and not very eutrophic (Rodwell *et al* 1991; Hall *et al* 2004). It is most extensive in the wetter parts of Britain, but usually occurs in soils where there is no great tendency for peat accumulation. The field layer can be very varied; the wetness and nutrient status of the soil determines what other species may occur, these being mainly grasses and herbaceous dicotyledons (Rodwell *et al* 1991; Hall *et al* 2004).

Two patches of young planted broadleaved woodland in the study area associated with the gatehouse most closely resemble W7 woodland. Here *Quercus* sp., *Betula* spp., *Alnus glutinosa* and *Corylus avellana* are planted over a damp field layer which contains *Juncus effusus*, *Filipendula ulmaria*, *Holcus lanatus*, *Poa* sp., *Deschampsia cespitosa* and *Caltha palustris*.

5.8.2 W23 Ulex europaeus – Rubus fruticosus scrub

Communities/sub-communities recorded: W23

The W23 community is dominated by *Ulex europaeus* (or in some cases *Cytisus scoparius*) and has a usually sparse and species-poor ground flora which may be totally absent. It is a community of acidic and free draining soils on gentle to steep, rocky slopes at low altitudes. The vegetation often develops after woodland clearance of, or on, abandoned pasture (Rodwell *et al* 1991; Averis *et al* 2004).

A few small patches of *Cytisus scoparius* dominated W23 are present around the study area associated with the gatehouse.

5.9 Non-NVC Communities & Categories

5.9.1 Overview

A number of non-NVC vegetation types or features were mapped during the survey. These were classified as follows. Codes used in the results Figures are given in parentheses:

- Conifer plantation (CP; gatehouse study area only);
- *Juncus effusus* acid grassland community (Je; gatehouse study area only);
- Reinstated peatland (RP; former Stronelairg access track only);
- Bare ground (BG);
- Bare or exposed peat (ExP); and
- Surface water (standing and/or running) (SW).

The CP, BG, ExP, SW features were lacking vegetation or floristically poor, and of negligible botanical importance. They are therefore not discussed further within this report.

The 'Je' acid grassland community is present as patches of a *Juncus effusus* dominated calcifuge grassland. This is vegetation in which very dominant and tall tussocks of *J. effusus* grow abundantly among a few shorter 'acid grassland' swards including frequent to occasional *Agrostis capillaris*, *Holcus lanatus*, *Rumex acetosa*, *Potentilla erecta* and *Galium saxatile*. This vegetation does not fit well into any NVC community as it lacks the wetland element of M6 and M23 *Juncus* spp. mires and has a more acidophilous flora than MG10 *Juncus effusus* rush-pasture; it is therefore classed separately. This vegetation is of limited botanical interest, but in light of the SEPA classification of potential GWDTEs the non-NVC types Je should also qualify for potential GWDTE status. The classification of moderate sensitivity is in line with other similar *Juncus* spp. dominated grassland communities (e.g. MG10).

The reinstated peatland (RP) category is used to describe a narrow strip of ground from the Glenshero Estate into Stronelairg Wind Farm. This area follows the line of the cabling route from Stronelairg to Melgarve Substation, which is flanked by a construction track. The track is being removed and the peatland reinstated along with restoration of the cabling corridor.

5.10 Invasive Non-Native Species

No invasive non-native species (INNS) were recorded within the NVC study area during surveys.

5.11 Notable Species

Betula nana (dwarf birch) was recorded a number of times within the NVC study area, see Annex A and EIAR Volume 3: Figure 6.3. This species is considered uncommon; however, it is only classified as a species of 'Least Concern' in the Vascular Plant Red Data List for Great Britain (Cheffings & Farrell, 2005).

6 CORRESPONDENCE WITH PHASE 1 HABITATS

For each of the above-described vegetation and habitats types found in this survey, Table 6-1-1 shows the equivalent habitats according to the Phase 1 habitat classification (JNCC, 2010) for this study area, taking into account the species composition and habitat quality. A map showing the dominant Phase 1 types throughout the study area is shown in EIAR Volume 3: Figure 6.2.

Table 6-1-1 Phase 1 habitat equivalents of NVC communities and other habitats recorded

NVC & Habitats Recorded	Phase 1 Equivalents
M2, M3, M17, M19, M20	E1.6.1: Blanket bog
M4, M6	E2.1: Flush and spring: acid/neutral
M10	E2.2: Flush and spring: basic
M32	E2.3: Flush and spring: bryophyte dominated

NVC & Habitats Recorded	Phase 1 Equivalents
M23, Je	B5: Marshy grassland
M15, M16	D2: Wet dwarf shrub heath
H9, H10, H12, H13, H14, H16, H21	D1.1: Dry dwarf shrub heath: acid
U4, U5, U6	B1.1: Acid grassland: unimproved
U7	D4: Montane heath/dwarf herb
U10	D3: Lichen/bryophyte heath
U20	C1.1: Bracken: continuous
S9	F1: Swamp
W7	A1.1.2: Woodland: broadleaved, plantation
W23	A2.1: Scrub: dense-continuous
CP	A1.2.2 Woodland: coniferous, plantation
ExP	E4: Bare peat
BG	J4: Bare ground
RP	J5: Other habitat
SW	G1: Standing water or G2 Running water

7 EVALUATION OF BOTANICAL INTEREST

7.1 Overview

NVC communities can be compared with a number of habitat classifications in order to help in the assessment of the sensitivity and conservation interest of certain areas. The following sections compare the survey results and the NVC communities identified against three classifications:

- SEPA guidance on GWDTE;
- Habitats Directive (92/43/EEC) Annex I habitats; and
- Scottish Biodiversity List (SBL) priority habitats

7.2 Groundwater Dependent Terrestrial Ecosystems (GWDTE)

SEPA has classified a number of NVC communities as potentially dependent on groundwater (SEPA, 2017). Wetlands or habitats containing these particular NVC communities are to be considered GWDTE unless further information can be provided to demonstrate this is not the case. Many of the NVC communities on the list are very common habitat types across Scotland, and some are otherwise generally of low ecological value. Furthermore, some of the NVC communities may be considered GWDTE only in certain hydrogeological settings.

Designation as a potential GWDTE does not therefore infer an intrinsic biodiversity value, and GWDTE status has not been used as criteria to determine a habitats respective conservation importance. There is however a statutory requirement to consider GWDTEs and the data gathered during the NVC surveys has been used to inform this assessment (see Annex D below for the GWDTE assessment).

SEPA guidance (2017) considers M16 wet heath to be a potentially highly dependent GWDTE, dependent on the hydrogeological setting. However, areas of M16 within the NVC study area were

not considered to be highly groundwater dependent based on information gathered, including the NVC data collected, community floristics, study area notes and characteristics, and the initial appraisal of the hydrogeological setting. A detailed appraisal of M16 groundwater dependency within the NVC study area and the specific correspondence with SEPA is provided in Annex E below. In summary, agreement was reached with SEPA that M16 in the NVC study area is very unlikely to be a high GWDTE and that its sensitivity should be reduced to be in line with the M15 wet heath present (i.e. no more than moderate sensitivity), and M16 should be considered in the same way as M15 in any assessments and provision of mitigation.

Using SEPA's (2017) guidance, and correspondence provided in Annex E on M16 wet heath, Table 7-1 shows which communities recorded within the NVC study area may be considered GWDTE. Those communities which may have limited (moderate) dependency on groundwater in certain settings are marked in yellow and NVC communities recorded that are likely to be considered high, or sensitive GWDTE in certain hydrogeological settings are highlighted in red.

Table 7-1-1 Potential GWDTE communities within the NVC study area

NVC Code	NVC Community Name
M15	*Trichophorum germanicum – Erica tetralix* wet heath
M16	*Erica tetralix – Sphagnum compactum* wet heath
U6	*Juncus squarrosus – Festuca ovina* grassland
Je	*Juncus effusus* acid grassland community[4]
M6	*Carex echinata – Sphagnum fallax/denticulatum* mire
M10	*Carex dioica - Pinguicula vulgaris* mire
M23	*Juncus effusus/acutiflorus – Galium palustre* rush pasture
M32	*Philonotis fontana – Saxifraga stellaris* spring
W7	*Alnus glutinosa – Fraxinus excelsior – Lysimachia nemoreum* woodland

The location and extent of all identified potential GWDTE are provided on an appropriate NVC based map; see EIAR Volume 3: Figure 6.3.

Within EIAR Volume 3: Figure 6.4 the potential GWDTE sensitivity of each polygon containing a potential GWDTE is classified on a four-tier approach as follows:

- 'Highly – dominant' where potential high GWDTE(s) dominate the polygon
- 'Highly - sub-dominant' where potential high GWDTE(s) make up a sub-dominant percentage cover of the polygon
- 'Moderately – dominant' where potential moderate GWDTE(s) dominate the polygon and no potential high GWDTEs are present
- 'Moderately - sub-dominant' where potential moderate GWDTE(s) make up a sub-dominant percentage cover of the polygon and no potential high GWDTEs are present.

[4] Considering the SEPA classification on GWDTEs the non NVC type Je should also qualify for potential GWDTE status and has therefore been included in Table 7-1. The classification of moderate sensitivity is keeping in line with other similar *Juncus* spp. dominated grassland communities.

Where a potential high GWDTE exists in a polygon it outranks any potential moderate GWDTE communities within that same polygon.

GWDTE sensitivity here has been assigned solely on the SEPA listings (SEPA, 2017), apart from M16 as described above. However, depending on a number of factors such as geology, superficial geology, presence of peat and topography, many of the other potential GWDTE communities recorded may also in fact be only partially groundwater fed or not dependent on groundwater. Determining the actual groundwater dependency of particular areas or habitat requires further assessment; this is provided in Annex D below.

In summary, the likelihood for GWDTE habitats to be dependent on groundwater, in this hydro-geological setting, has been reviewed. The vegetation communities in this environment are believed to be influenced by high levels of rainfall, low infiltration rates and low rates of evaporation. It is therefore considered unlikely that there are notable areas of groundwater fed habitats. Groundwater is assessed as being focussed to localised springs associated with the near surface weathered zone. The potential impact on localised groundwater flows paths has been discussed with SEPA through a series of pre-application discussions (EIAR Volume 4: Technical Appendix 6.1, Annex E). Mitigation will be built into the design to maintain hydrological flow paths under tracks or via cut-off drains around non-linear infrastructure

7.3 Annex I Habitats

7.3.1 Overview

A number of NVC communities can also correlate to various Annex I habitat types. However, the fact that an NVC community can be attributed to an Annex I type does not necessarily mean all instances of that NVC community constitute Annex I habitat. Its Annex I status can depend on various factors such as quality, extent, species assemblages, geographical setting, substrates etc.

Using Joint Nature Conservation Committee (JNCC) Annex I habitat listings and descriptions[5], which have then been compared with survey results and field observations, the following NVC communities within the NVC study area which may constitute Annex I habitat are shown in Table 7-2-1.

Table 7-2-1 NVC Communities recorded and corresponding Annex I habitat types

NVC Code	NVC Community Name	Annex I Code	Annex I Title
M2	*Sphagnum cuspidatum/fallax* bog pool community	7130	Blanket bog (examples associated with M17-M20)
M3	*Eriophorum angustifolium* bog pool community	7130	Blanket bog (examples associated with M17-M20)
M4	*Carex rostrata - Sphagnum fallax* mire	7140	Transition mires and quaking bogs
M10, M10a	*Carex dioica - Pinguicula vulgaris* mire	7230	Alkaline fens
M15, M15a, M15b, M15c, M15d	*Trichophorum germanicum – Erica tetralix* wet heath	4010 or 7130	Northern Atlantic wet heaths with *Erica tetralix*, or blanket bog where peat depth is greater than 0.5m

[5] http://jncc.defra.gov.uk/page-1523

NVC Code	NVC Community Name	Annex I Code	Annex I Title
M16d	*Erica tetralix – Sphagnum compactum* wet heath	4010 or 7130	Northern Atlantic wet heaths with *Erica tetralix*, or blanket bog where peat depth is greater than 0.5m
M17, M17a, M17b, M17c	*Trichophorum germanicum – Eriophorum vaginatum* blanket mire	7130	Blanket bog
M19, M19a, M19b, M19c	*Calluna vulgaris – Eriophorum vaginatum* blanket mire	7130	Blanket bog
M20	*Eriophorum vaginatum* blanket mire	7130	Blanket bog
H9	*Calluna vulgaris – Deschampsia flexuosa* heath	4030	European dry heaths
H10, H10b	*Calluna vulgaris - Erica cinerea* heath	4060	Alpine and boreal heaths
H12, H12a, H12b	*Calluna vulgaris – Vaccinium myrtillus* heath	4060	Alpine and boreal heaths
H13, H13b	*Calluna vulgaris – Cladonia arbuscula* heath	4060	Alpine and boreal heaths
H14, H14b	*Calluna vulgaris – Racomitrium lanuginosum* heath	4060	Alpine and boreal heaths
H16, H16c	*Calluna vulgaris - Arctostaphylos uva-ursi* heath	4060	Alpine and boreal heaths
H21a	*Calluna vulgaris – Vaccinium myrtillus – Sphagnum capillifolium* heath	4060	Alpine and boreal heaths
U7	*Nardus stricta – Carex bigelowii* grass-heath	6150	Siliceous alpine and boreal grasslands
U10, U10b	*Carex bigelowii - Racomitrium lanuginosum* moss-heath	6150	Siliceous alpine and boreal grasslands

Further details on the inclusion or omission of certain NVC communities/sub-communities and/or Annex I types are also provided below.

7.3.2 7130 Blanket bog

The blanketing of the ground with a variable depth of peat gives this habitat type its name and results in the various morphological types according to their topographical position. Blanket bogs show a complex pattern of variation related to climatic factors, particularly illustrated by the variety of patterning of the bog surface in different parts of the UK. Such climatic factors also influence the floristic composition of bog vegetation.

'Active' bogs are defined as supporting a significant area of vegetation that is normally peat-forming. Typical species include the important peat-forming species, such as *Sphagnum* spp. and *Eriophorum* spp., or *Molinia caerulea* in certain circumstances, together with *Calluna vulgaris* and other ericaceous species. The most abundant NVC blanket bog types are M17, M18, M19, M20 and M25.

Annex I type 7130 Blanket bog therefore correlates directly with a number of NVC communities within the NVC study area such as the M17, M19 and M20 mires. However, 7130 Blanket bog can also include bog pool communities (M1-M3) where these occur within blanket mires such as M17-M20. As such true bog pool examples of M2 and M3 within the NVC study area are also assigned to the blanket bog Annex I type, as they are often associated with areas of M17, M19 and M20 mire.

M15[6] and M16 wet heaths can also fall within the 7130 Blanket bog Annex I type where the peat depth underlying these communities is greater than 0.5m. M15 and M16 also fall under the 4010

[6] Excluding M15a *Carex panicea* sub-community, due to its flushed nature over generally shallower substrates.

Northern Atlantic wet heaths with *Erica tetralix* Annex I type, so these NVC communities do not need blanket bog status to be recognised as of Annex I conservation interest. However, areas of M15 and M16 have been categorised as both (i.e. 4010_7130) as the stands within the NVC study area are variable, some appearing as true wet heath, but also often present as stands of degraded bog with a drying surface and wet heath vegetation on peat over 0.5m in depth.

7.3.3 7140 Transition mires and quaking bogs

All examples of M4 *Carex rostrata* - *Sphagnum fallax* mire within the NVC study area were assigned to the Annex I type Transition mires and quaking bogs. The term 'transition mire' relates to vegetation that in floristic composition and general ecological characteristics is intermediate between acid bog and alkaline fen.

7.3.4 7230 Alkaline fens

Alkaline fens consist of a complex assemblage of vegetation types characteristic of sites where there is tufa and/or peat formation with an elevated water table and a calcareous base-rich water supply. The core vegetation is short sedge mire. All examples of M10 mire in the NVC study area fall within this Annex I habitat type.

7.3.5 4010 Northern Atlantic wet heaths with Erica tetralix

Wet heath usually occurs on acidic, nutrient-poor substrates, such as shallow peats or sandy soils with impeded drainage. The vegetation is typically dominated by mixtures of *Erica tetralix*, *Calluna vulgaris*, grasses, sedges and *Sphagnum* bog-mosses. All examples of M15 and M16 wet heath fall within the 4010 Northern Atlantic wet heaths category, however as described above they can also be classified under 7130 Blanket bog where deeper peat exists, and as such M15 and M16 is classified as both 4010 and 7130, as per above.

7.3.6 4060 Alpine and boreal heaths

Alpine heaths develop above the natural altitudinal tree-line, and boreal heaths below the tree-line in gaps among scrubby high-altitude woods or as replacements for those subalpine woods historically lost due to grazing and burning. On lower slopes, boreal heaths grade into floristically-similar 4030 European dry heaths. The dominant plants are usually dwarf-shrubs such as *Calluna vulgaris, Vaccinium myrtillus* or *Juniperus communis*, which are low-growing or prostrate owing to exposure to high winds or prolonged snow cover at moderately high altitudes.

Alpine and boreal heaths occur on acid rocks on mountains, both on exposed lower summits and ridges and on sheltered slopes. Exposure or snow-lie, which suppress the growth of dwarf-shrubs, also favours the growth of characteristic lichens and bryophytes. Some of these heath types are particularly susceptible to disturbance, especially by fire or trampling.

All dry heath in the NVC study area (except a small patch of H9) is considered to fall within this Annex I type. The H13 and H14 heath present falls into alpine heaths. The much smaller and more fragmented stands of H10, H12, H16 and H21 present fall within the classification of boreal heaths, and not European dry heaths due to the altitude of the NVC study area and these stands. The small patch of H9 by the gatehouse study area could fall within the 4030 European dry heaths category.

7.3.7 6150 Siliceous alpine and boreal grasslands

Siliceous alpine and boreal grasslands are one of the few predominantly near-natural habitats remaining in the UK. The habitat is the most extensive type of vegetation in the high mountain zone,

above an altitude of about 750m. It often forms large continuous tracts, covering summit plateaux and the tops of the higher summits and ridges. The habitat comprises a range of grassland types whose composition is influenced by contrasting extremes of exposure and snow-lie. Late-lie snow-bed communities dominated by bryophytes and dwarf-herbs are also included within the definition of the habitat. The habitat is vulnerable to nutrient inputs and physical damage such as occur due to dunging and urination by grazing animals, acid deposition, human and animal trampling, and use of all-terrain vehicles.

The stands of U7 and U10 within the NVC study area, the largest and most notable of which is over Meall na h-Aisre, fall within this Annex I type. U10 moss-heath occurs on windswept ground blown clear of snow during winter, and is the most extensive sub-type of the habitat across most of the UK. Where snow-lie builds up, such moss-heath gives way initially to U7 *Nardus – Carex* grass-heath.

7.4 Scottish Biodiversity List Priority Habitats

The SBL is a list of animals, plants and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland. The SBL was published in 2005 to satisfy the requirement under Section 2(4) of The Nature Conservation (Scotland) Act 2004.

The SBL identifies habitats which are the highest priority for biodiversity conservation in Scotland: these are termed 'priority habitats'. Some of these priority habitats are quite broad and can correlate to a large number of NVC types.

The relevant SBL priority habitat types (full descriptions of which can be found on SNHs website[7]), and associated NVC types recorded within the NVC study area are as follows:

- **Blanket bog:** M2, M3, M17, M19, M20 (M2/M3 where associated with M17/M19/M20), and M15[8]/M16 where peat depth is greater than 0.5m.
- **Upland flushes, fens and swamps**: M4, M6, M10, M32 and S9.
- **Upland heathland:** M15, M16, H9, H10, H12, H16 and H21.
- **Mountain heaths:** H13, H14, U7 and U10.

These SBL priority habitats correspond with UK Biodiversity Action Plan (BAP) Priority Habitats[9]. This information is also summarised in Table 7-3 below.

7.5 Summary

Table 7-3-1 provides a summary of all the NVC communities recorded within the NVC study area, and any associated habitat sensitivities as described in the sections above.

Table 7-3-1 Summary of study area NVC communities and sensitivities

NVC Codes Recorded	Potential GWDTE Status	Annex I Code & Description	SBL Priority Habitat Type
Mires, Flushes & Springs			
M2	-	7130 Blanket bogs (examples associated with M17-M20)	Blanket bog
M3	-	7130 Blanket bogs (examples associated with M17-M20)	Blanket bog

[7] https://www.nature.scot/scotlands-biodiversity/habitat-definitions
[8] Excluding the M15a *Carex panicea* sub-community, due to its general flushed nature over shallower substances.
[9] http://jncc.defra.gov.uk/page-5718

NVC Codes Recorded	Potential GWDTE Status	Annex I Code & Description	SBL Priority Habitat Type
M4	-	7140 Transition mires and quaking bogs	Upland flushes, fens and swamps
M6, M6a, M6b, M6c	High	-	Upland flushes, fens and swamps
M10, M10a	High	7230 Alkaline fens	Upland flushes, fens and swamps
M17, M17a, M17b, M17c	-	7130 Blanket bogs	Blanket bog
M19, M19a, M19b, M19c	-	7130 Blanket bogs	Blanket bog
M20	-	7130 Blanket bogs	Blanket bog
M23b	High	-	-
M32, M32a	High	-	Upland flushes, fens and swamps
Wet Heaths			
M15, M15a, M15b, M15c, M15d	Moderate	4010 Northern Atlantic wet heaths with *Erica tetralix* or 7130 Blanket bogs (where peat is greater than 0.5m deep)	Upland heathland or blanket bogs (where peat is greater than 0.5m deep)
M16d	High	4010 Northern Atlantic wet heaths with *Erica tetralix* or 7130 Blanket bogs (where peat is greater than 0.5m deep)	Upland heathland or blanket bogs (where peat is greater than 0.5m deep)
Dry & Montane Heaths			
H9	-	4030 European dry heaths	Upland heathland
H10b	-	4060 Alpine and Boreal heaths	Upland heathland
H12a, H12b,	-	4060 Alpine and Boreal heaths	Upland heathland
H13, H13b	-	4060 Alpine and Boreal heaths	Mountain heaths
H14, H14b	-	4060 Alpine and Boreal heaths	Mountain heaths
H16, H16c	-	4060 Alpine and Boreal heaths	Upland heathland
H21a	-	4060 Alpine and Boreal heaths	Upland heathland
Calcifugous Grasslands & Montane Communities			
U4, U4a, U4d, U4e	-	-	-
U5, U5a, U5b, U5d, U5e	-	-	-
U6, U6a, U6c, U6d	Moderate	-	-
U7	-	6150 Siliceous alpine and boreal grasslands	Mountain heaths
U10, U10b	-	6150 Siliceous alpine and boreal grasslands	Mountain heaths
U20	-	-	-
Swamp			
S9, S9a	-	-	Upland flushes, fens and swamps
Woodland & Scrub			
W7	High	-	-
W23	-	-	-

8 SUMMARY

MacArthur Green carried out NVC and habitat surveys within the Glenshero NVC study area in 2017 and 2018 in order to identify those areas of vegetation communities with the greatest ecological or conservation interest.

In total 28 NVC communities were recorded within the respective study area along with various associated sub-communities, however only a small number of communities accounted for the majority of the NVC study area, as described above.

The NVC surveys have revealed the presence of a number of potential GWDTE habitats, as well as Annex I and Scottish Biodiversity List Priority Habitats, as summarised in Table 7-3 above.

The likelihood for GWDTE habitats to be dependent on groundwater, in this hydro-geological setting, has been reviewed. The vegetation communities in this environment are believed to be influenced by high levels of rainfall, low infiltration rates and low rates of evaporation. It is therefore considered unlikely that there are notable areas of groundwater fed habitats. Groundwater is assessed as being focussed to localised springs associated with the near surface weathered zone. The potential impact on localised groundwater flows paths will be mitigated through the design of the infrastructure including floating tracks and cross drains to maintain hydrological flow paths under tracks, or via cut-off drains around non-linear infrastructure.

GLOSSARY

acidophilous: plants/bryophytes that prefer to grow in an acidic environment.

base-poor: environments which have few chemical bases, they are dominated by environmental acids (usually organic acids) and so are acidic.

base-rich: environments which are neutral or alkaline.

base-richness: the level in soil or water of chemical bases, such as calcium or magnesium ions. Chemical bases are alkalis. Many plants and bryophytes are restricted to base-rich or base-poor environments.

basiphilous: plants/bryophytes that prefer to grow in a basic environment.

calcareous: calcareous grassland forms on soils that are base-rich.

calcicolous: a plant that grows and thrives in soil rich in lime.

calcifugous: growing or living in acid soil.

circumneutral soil: nearly neutral, having a pH between 6.5 and 7.5.

dicotyledon: a plant that produces flowers and has two cotyledons (i.e. embryonic leaves).

forb: a herbaceous flowering plant that is not a graminoid (grasses, sedges and rushes).

graminoid: grasses; monocotyledonous, usually herbaceous plants with narrow leaves growing from the base. They include the true grasses, of the family Poaceae (also called Gramineae), as well as the sedges (Cyperaceae) and the rushes (Juncaceae).

humic rankers: shallow soils with an organic-rich (humose) surface layer overlying a weakly developed, thin subsoil on to rock.

mesophytic: a land plant that grows in an environment having a moderate amount of moisture, neither a particularly dry nor particularly wet environment.

mesotrophic grassland: neutral grassland, characterised by vegetation dominated by grasses and herbs on a range of circumneutral soils.

monocotyledons: flowering plants group which have just one cotyledon.

mor: forest humus that forms a layer of largely organic matter distinct from the mineral soil beneath.

mosaic: a pattern of two or more vegetation types disposed in intimate relationships to one another.

oligotrophic: lacking in plant nutrients.

ombrogenous: dependant on rain for its formation. Ombrogenous bog is a peat-forming vegetation community lying above groundwater level: it is separated from the mineral soil, and is thus

dependent on rain water for mineral nutrients. The resulting lack of dissolved bases gives strongly acidic conditions. Two types of ombrogenous bogs are commonly distinguished: raised bogs and blanket bogs.

plagioclimax community: an area or habitat in which anthropogenic influences have prevented the habitat/ecosystem developing further. It may have been prevented from reaching its full climatic climax or shifted towards a different climax type by activities such as burning, grazing, vegetation clearance etc.

pleurocarpous: A type of moss in which the female sex organs and capsules are borne on short, lateral branches, and not at the tips of branches. Pleurocarpous mosses tend to form spreading carpets rather than erect tufts.

podsol: a soil that develops in temperate to cold moist climates under coniferous or heath vegetation; an organic mat over a grey leached layer.

siliceous: containing abundant silica; (plants) growing in or needing soil rich in silica.

soligenous: where water movements are predominantly lateral. Produced by inflow of surface water or rise of groundwater and not completely by locally precipitated water.

topogenous mire: a type of mire that forms under climatic conditions of reduced rainfall, with consequent lower humidity and summer drought, which restrict the growth of wetland vegetation to areas where precipitation is concentrated (e.g. valley bottoms).

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ANNEX A. NVC TARGET NOTES

A number of target notes were also made during surveys, often to pinpoint springs/flushes, or an area or species of interest, these target notes are shown on EIAR Volume 3: Figure 6.3 and detailed within Table A-1 below. A sample of corresponding target note photographs is provided in Annex B, general photographs are provided in Annex C.

Table A. 1 Study area target notes

Target Note ID	Grid Ref	NVC Community	Feature Type	Description
01	NH 49417 98497	M15a	Flush	Species present include *Festuca vivipara, Nardus stricta, Sphagnum papillosum, S. palustre, S. capillifolium, Carex echinata, Juncus squarrosus.*
02	NN 49706 98873	M10a	Flush	Area of extensive flushing.
03	NN 49716 98483	M10a	Flush	Area of flushing.
04	NN 49721 98884	M32a	Spring	Spring.
05	NN 49769 98515	M10a	Flush	Area of flushing.
06	NN 49793 98542	M10a	Flush	Area of flushing.
07	NN 49825 99270	M32a	Spring	Couple of M32a springs.
08	NN 49845 98510	M10a	Flush	Few flushes in this area.
09	NN 49886 98851	n/a	Uncommon species	*Betula nana*. Photograph B1 in Annex B.
10	NN 49948 98475	n/a	Uncommon species	Some *Betula nana* in summit heath.
11	NN 49962 98569	M10a	Flush	Area of abundant M10a flushing - relatively species-poor.
12	NN 49980 98470	M10a	Flush	Area with flushes.
13	NN 50162 98163	M10a	Flush	Number of M10a flushes in this area with small *Carex* spp., Erica tetralix, *Pinguicula vulgaris*, *Viola palustris*, *Narthecium ossifragum* and mosses.
14	NN 50299 98409	M32a/M10a	Spring & Flush	M32a springhead with M10a flushing below.
15	NN 50396 98241	M32a	Spring	Springhead dominated by *Philonotis fontana* along with some *Sphagnum denticulatum*, *Carex* spp., *Eriophorum angustifolium*, *Festuca vivipara* and *Aulacomnium palustre*.
16	NN 50472 99312	M32a	Spring	Spring dominated with *Sphagnum denticulatum*.
17	NN 50644 98019	M10a	Flush	Flush with abundant small sedges, including *Carex panicea, C. viridula, C. hostiana, C. pulicaris* and lots of *Pinguicula vulgaris* and *Narthecium ossifragum*. Also, some Trichophorum germanicum, *Erica tetralix*, *Eriophorum angustifolium*, *Drosera rotundifolia*,

Target Note ID	Grid Ref	NVC Community	Feature Type	Description
				Selaginella selaginoides, *Scorpidium* sp.
18	NN 50682 99582	M10a	Flush	Area of flushing.
19	NN 50731 98686	n/a	Uncommon species	Area of bog with some *Betula nana.*
20	NH 50846 00288	M10a	Flush	Area of flushing.
21	NH 50893 00308	n/a	Uncommon species	*Betula nana* in wet heath.
22	NN 51041 99830	M32a/M10a	Spring & Flush	M32a seepages into large area of M10a flushing.
23	NN 51178 98508	n/a	Uncommon species	Area of bog with some *Betula nana*.
24	NH 51205 00110	M32a/M10a	Spring & Flush	M32a seepage and associated area of M10a flushing below.
25	NN 51361 99728	M10a	Flush	Area of M10a flushing on slope.
26	NN 51714 99910	M32a	Spring	Area with a number of M32a springs which descend into flushes.
27	NN 51752 99941	M10a	Flush	Area of M10a flushing with abundant *Sphagnum denticulatum* and *Carex* spp. sparser.
28	NN 51939 99426	M32a	Spring	Cluster of springs.
29	NH 52136 00066	M32a	Spring	Spring and flush. *Polytrichum commune* and *Sphagnum fallax* also present.
30	NH 52143 00177	M10a	Flush	Area of M10a flushing cross-slope.
31	NH 52209 00304	M32a	Spring	Spring and flush.
32	NH 52317 00346	M32a	Flush	Seepage area out of base of rocky slope.
33	NH 52324 00369	M32a	Flush	Seepage area.
34	NH 52328 00372	M32a	Spring	*Sphagnum* spring and flush.
35	NH 52484 00432	M10a	Flush	Flush.
36	NN 52829 98474	M32a	Spring	Spring and flush.
37	NN 52833 98411	M10a	Flush	Flush.
38	NN 52865 98415	M10a	Flush	Flush.
39	NN 52896 99169	M32a	Flush	*Sphagnum* spring and flush.
40	NN 52943 99219	M32a	Flush	*Sphagnum* spring and flush.
41	NN 53032 99317	M32a	Flush	*Sphagnum* spring and flush.
42	NN 53121 99692	M10a	Flush	Flush.
43	NN 53189 98195	M32a	Spring	2 x *Sphagnum* spring and flushes.

Target Note ID	Grid Ref	NVC Community	Feature Type	Description
44	NN 53212 98615	M10a	Flush	*Sphagnum* flush with *S. fallax* and *S. capillifolium.*
45	NN 53594 98085	M32a	Flush	Spring and flush.
46	NN 53740 98304	M32a/M10a	Spring	Spring and M10a flush.
47	NN 53760 98380	M10a	Flush	Flush.
48	NN 54810 99837	M32a	Spring	Spring.
49	NN 54360 99720	M32a	Spring	Spring.
50	NH 56235 00359	M32a	Spring	Couple of M32a springs with M10a flushing below.
51	NH 56073 00128	M10a	Flush	Number of M10a flushes on slope.
52	NN 51372 99638	M32a/M10a	Spring & Flush	Spring and abundant M10 flushing on slopes.
53	NN 51621 99423	M32a/M10a	Spring & Flush	M32a spring and M10a flushes downslope.
54	NN 51749 99421	M32a/M10a	Spring & Flush	M32a spring and M10a flushes downslope.
55	NN 51667 99415	M32a/M10a	Spring & Flush	M32a spring and M10a flushes downslope.
56	NN 53029 99201	M32a/M10a	Spring & Flush	M32a spring and M10a flushes downslope.
57	NN 53791 98115	M32a	Spring	Spring and upwelling water.
58	NN 50962 99566	M32a/M10a	Spring & Flush	Spring & Flush
59	NN 50948 99622	M32a/M10a	Spring & Flush	Spring & Flush
60	NN 50953 99600	M32a	Spring	Spring
61	NN 50989 99540	M32a/M10a	Spring & Flush	Spring & Flush
62	NN 51085 99544	M32a/M10a	Spring & Flush	Spring & Flush
63	NN 51094 99567	M32a/M10a	Spring & Flush	Spring & Flush
64	NN 50848 99493	M32a	Spring	Spring
65	NN 50773 99454	M32a	Spring	Spring
66	NN 50949 99279	M32	Spring & Rill	Spring & Rill
67	NN 50974 99276	M32a	Spring	Spring
68	NN 50994 99248	M32a	Spring & Flush	Spring & Flush. Photograph B2 in Annex B.
69	NN 50968 99242	M32a	Spring & Rill	Spring & Rill. Photograph B3 in Annex B.
70	NN 50997	M32a	Spring & Flush	Spring & Flush

Target Note ID	Grid Ref	NVC Community	Feature Type	Description
	99255			
71	NN 51543 99482	M32a	Spring & Flush	Spring & Flush
72	NH 51453 00768	M32a	Spring & Flush	Spring & Flush. Photograph B4 in Annex B.
73	NH 51440 01890	M32a/M10a	Spring	Spring
74	NH 51883 02433	M32a	Spring	Spring

ANNEX B. TARGET NOTE PHOTOGRAPHS

The following photographs correlate to target notes described within Annex A, Table A.1. Photographs are not provided here for all target notes, due to the similarity in many photographs.

Photo B1: Target Note 09 *Betula nana*

Photo B2: Target Note 68, M32 spring and flush.

Photo B3: Target Note 69, M32 spring and flush.

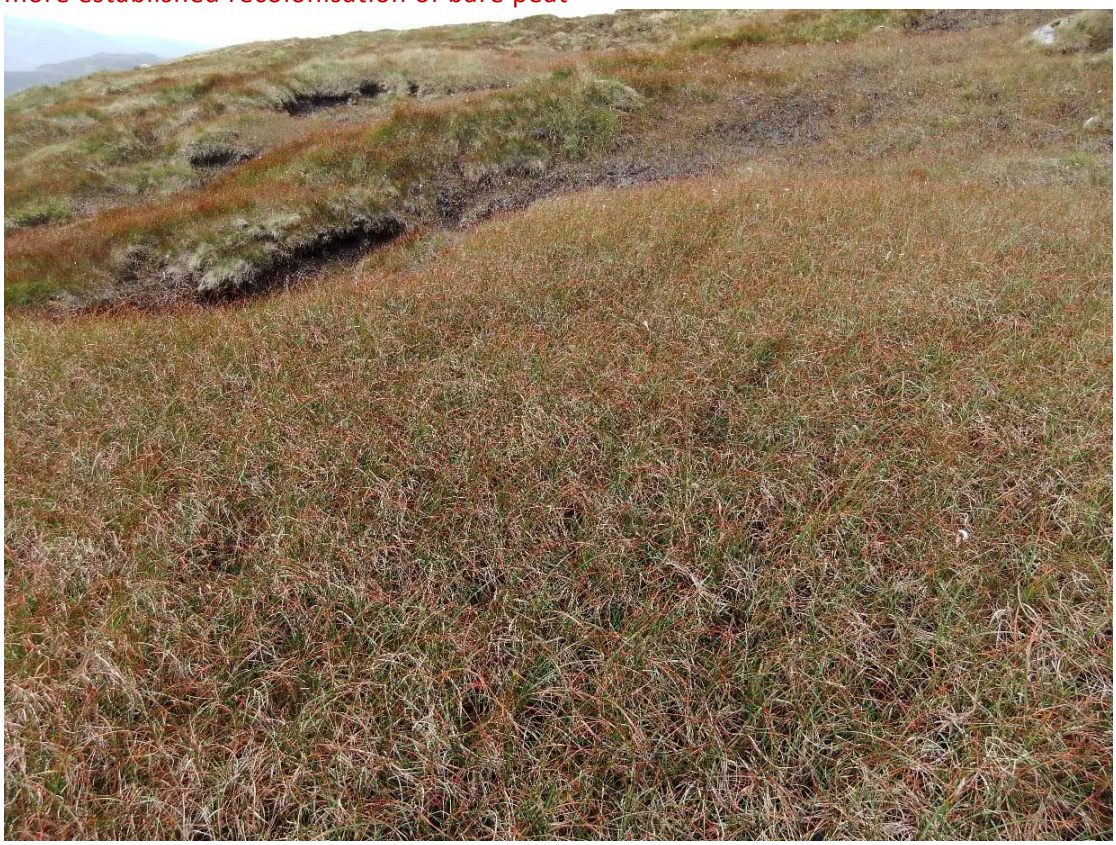
Photo B4: Target Note 72, M32 spring and flush.

ANNEX C. GENERAL COMMUNITY PHOTOGRAPHS

The following selected photographs are provided to give a visual representation to a number of the main community types present within the NVC study area and their condition.

Photograph C1: M3 *Eriophorum angustifolium* community colonising bare peat

Photograph C2: M3 *Eriophorum angustifolium* community in foreground, thicker sward and more established recolonisation of bare peat



Photograph C3: Stony and flushed M10 *Carex dioica - Pinguicula vulgaris* mire

Photograph C4: M15 *Trichophorum germanicum – Erica tetralix* wet heath

Photograph C5: Species-poor M16 *Erica tetralix – Sphagnum compactum* wet heath, dominated by *Trichophorum germanicum*

Photograph C6: Intact M17 *Trichophorum germanicum – Eriophorum vaginatum* blanket mire

Photograph C7: Eroding M17 mire

Photograph C8: Overview of the scale of mire hagging present in the NVC study area

Photograph C9: Hagged mire

Photograph C10: Example of where peat has been eroded away to reveal underlying substrates, hagg gullies convey water around the NVC study area

Photograph C11: Eroded mire with hagg tops of remnant and drying bog vegetation, interspersed with patches of the M3 *Eriophorum angustifolium* community and bare peat

Photograph C12: Area of intact M19 *Calluna vulgaris – Eriophorum vaginatum* blanket mire with limited erosion

Photograph C13: M19 mire with erosion

Photograph C13: M32a *Philonotis fontana – Saxifraga stellaris* spring, *Sphagnum denticulatum* sub-community (bright green area)

Photograph C14: M32 spring feeding into M10 stony flush

Photograph C15: H12 *Calluna vulgaris – Vaccinium myrtillus* dry heath

Photograph C16: H13 *Calluna vulgaris – Cladonia arbuscula* montane heath

Photograph C17: H14 *Calluna vulgaris – Racomitrium lanuginosum* montane heath

Photograph C18: H21 *Calluna vulgaris – Vaccinium myrtillus – Sphagnum capillifolium* dry heath

Photograph C19: U7 *Nardus stricta – Carex bigelowii* grass-heath, with *Nardus* dominant

Photograph C20: U7 grass-heath, with *Carex bigelowii* dominant

Photograph C21: U10 *Carex bigelowii - Racomitrium lanuginosum* moss-heath over Meall na h-Aisre

Photograph C22: S9 *Carex rostrata* swamp at Dubh Lochan, east of Creag an Dearg Lochain

ANNEX D. GWDTE ASSESSMENT

NVC communities recorded within the study area have been mapped as GWDTE based on Appendix 4 of SEPA's Land Use Planning System (LUPS) Guidance Note 31 (September, 2017), with the exception of M16. As stated in Section of 7.2, and summarised again in this Annex, it has been agreed with SEPA (Annex E) that M16 communities will be treated the same as M15 (moderate dependency), in this hydrogeological setting.

The potential GWDTE sensitivity of each polygon containing a potential GWDTE is classified on a four-tier approach as follows:

- 'Highly – dominant' where potential high GWDTE(s) dominate the polygon
- 'Highly - sub-dominant' where potential high GWDTE(s) make up a sub-dominant percentage cover of the polygon
- 'Moderately – dominant' where potential moderate GWDTE(s) dominate the polygon and no potential high GWDTEs are present
- 'Moderately - sub-dominant' where potential moderate GWDTE(s) make up a sub-dominant percentage cover of the polygon and no potential high GWDTEs are present.

Where a potential high GWDTE exists in a polygon it outranks any potential moderate GWDTE communities within that same polygon.

Hydrogeological Setting

The study area is located at high altitude (approximately 800 m AOD) and on a hydrological watershed. The underlying aquifer is stated to be of low productivity[10] with only small amounts of groundwater, generally found in the near surface weathered zone and in secondary fractures (evident as rare springs). There are areas of standing water on the plateau, at the watershed. The vegetation communities in this environment are believed to be influenced predominantly by high levels of rainfall, late lying snow, low infiltration rates and low rates of evaporation. It is therefore considered unlikely that there are notable areas of groundwater fed habitats in this hydrogeological setting.

As noted above, groundwater will be focussed to springs occurring on the steep side slopes of the site in near surface weathered zones.

Assessment of GWDTEs

NVC communities have been assigned a GWDTE sensitivity where they are within 100 m of excavations less than 1 m in depth, and 250 m of excavations greater than 1 m in depth. The buffers stated are defined in SEPA's Land Use Planning System (LUPS) Guidance Note 31 (September, 2017), and are shown in EIAR Volume 3: Figure 6.5.

The dominant NVC community within nearly all the Highly Dependent polygons is recorded as M16d (Wet Dwarf Shrub Heath). SEPA's LUPS-31 Guidance states that M16 could be highly dependent on groundwater, dependent on the hydrogeological setting. As stated in Section 7.2 of this report, and detailed in pre-application discussions with SEPA (Annex E, letter from MacArthur Green to SEPA dated 20th February 2018), M16 peatland at this site is considered to be ombrogenous and rainfall-

[10] British Geological Survey, Onshore GeoIndex (http://mapapps2.bgs.ac.uk/geoindex/home.html), accessed November 2017.

fed rather than 'highly' groundwater dependent. This is based on the character of the habitat as surveyed at this site, combined with communities being located on a low productivity underlying aquifer, with very small potential zones of groundwater contribution or sub-catchments upslope of areas of M16. If there is an input of groundwater to areas of M16, it is considered to be of very low volume and of negligible significance in maintaining the necessary moisture content of the habitat type. It is proposed M16 at the site is considered to have a 'low' dependency on groundwater and will be assessed in the same regards as the potentially moderately dependent M15 wet heath, whereby suitable mitigation measures will be put in place to minimise hydrological impacts on these habitats.

Remaining GWDTE within SEPA's specified buffer areas have been assessed. Highly Dependent GWDTE are dominated largely by M10 areas of flushing and M32 springs. The occurrence of these communities supports the understanding of the hydrogeology of the site with groundwater being present in the form of springs from near surface weathered bedrock and secondary fractures. A small number of Highly Sub-dominant polygons are evident within the 250 m buffer of a number of turbines (EIAR Volume 3: Figure 6.5); these are assessed further below. The greatest concentration of Highly Sub-dominant polygons is focussed to a 100 m buffer of the existing access track between the existing Stronelairg Wind Farm and the proposed development, as well as the proposed linking East-West track. The location of these habitats within the central and eastern areas of the site also reflects indicative areas of bedrock at or near the ground surface as shown in the Peat Hazard Landslide Risk Assessment (PHLRA) (EIAR Volume 4: Technical Appendix 2.6, Figure 4-1).

Impact of the Access Track between Stronelairg and the Proposed Development

The access track between Stronelairg Wind Farm and the proposed development currently exists, though would require upgrading. The direct loss of habitat as a result of upgrading the track is assessed in EIAR Volume 2: Chapter 6 Ecology and the main body of this report. The indirect impact on localised groundwater from upgrading of the existing access track is assessed as negligible, with groundworks aligned directly alongside the current infrastructure.

Impact of the Proposed Gatehouse

The only area where Highly Dominant GWDTE polygon features have been located is at the proposed Gatehouse, where there is an existing access track and Gatehouse for Stronelairg Wind Farm. As the Gatehouse would aim to be micro-sited on the existing hardstanding, it is not assessed as having an effect on any surrounding groundwater flow paths.

Impact of the Proposed Development

The potential impact of the proposed development on localised groundwater flow paths is considered below and was issued to SEPA for Pre-Application discussion on the 19th June 2018 (Annex E). SEPA stated that with suitable mitigation, the layout is considered acceptable in relation to its impact on GWDTE. Their detailed response is included in Annex E (letter from SEPA to MacArthur Green dated 18th July 2018). Some additional refinements have since been made to further reduce the impact and are included below.

The site layout was designed based on the principles of avoidance first, minimisation and mitigation across all site constraints. The final layout is considered as having the least environmental impact; a

detailed history of the design iteration is provided in EIAR Volume 2: Chapter 3: Design Evolution and Alternatives.

GWDTE that are within SEPA's buffers are assessed below.

- East – West linking access track: the access track is within 100 m of M10a and M32a Target Notes. These habitats are close to areas of emergent water; not all areas are thought to be dependent on groundwater due to the location close to the watershed and may be in part driven by rainfall and late lying snow.

  The design of the access track is being reviewed to assess the feasibility of floating this section of access track. Floating the access track where appropriate will reduce the impact on shallow sub-surface flow paths. If the track cannot be floated due to engineering constraints, it is proposed that a number of cross drains would be constructed where there are downslope GWDTE present, to maintain the hydrological connectivity across this area of the access track. This mitigation would be built into the detailed design and stated in the final version of the Construction Environmental Management Plan (CEMP) (which would be submitted as a condition of consent). The Outline CEMP (EIAR Volume 4: Technical Appendix 2.1) notes that floating track construction would be adopted where the ground conditions require.

  Relocation of the East – West linking access track to avoid these areas was considered in the Design Iteration process. The location of the track is constrained and the proposed location is considered as having the least environmental impact. Full details of the Design Iteration process are provided in EIAR Volume 2: Chapter 3: Design Evolution and Alternatives.

- T7 and T9: An area of Highly Sub-dominant GWDTE is located approximately 90 m downgradient of the infrastructure. This habitat is largely located on peat over 0.5 m in depth and based on the aerial imagery is directly over an area of peat hagging with wet surface conditions that appear to be associated with the superficial deposits (rather than groundwater). Whilst the feature is not likely to be solely dependent on groundwater, it is proposed that access tracks would be floated where they lie within the buffer to minimise any potential impacts. The localised footprint of the turbine foundation is unlikely to have a significant effect on the feature though cut-off drains would be design around bases to ensure flows upslope are discharged diffusely downslope.
  A potential borrow pit search area is located adjacent to T7. The location has avoided areas of peat (> 0.5 m) though lies within the 250 m GWDTE buffer. As the borrow pit would require a larger area of intrusive works, ground investigation should be completed at the detailed design stage to establish if there is localised groundwater within this area, prior to requesting an application for de-watering (should this search area be used). If excavation is required, habitat monitoring should be undertaken pre, during and post construction of the borrow pit, to check if the habitat is drying out and trigger mitigation if required. Monitoring requirements would be stated in the final CEMP.
- T11 and T38: Located approximately 120 m to the north-east of T11 and its associated infrastructure, this Highly Sub-dominant habitat is mapped directly along Allt Coire Iain Oig incised watercourse. The habitats are assessed as being dependent on the surface water feature and not dependent on sub-surface flows in the area of the infrastructure. A Highly Sub-dominant community similarly occurs immediately downgradient, and adjacent to, T38.

These habitats are located alongside Blackcorrie and Burn and depressions likely to convey surface water. These habitats are also assessed as being largely dependent on surface water features and unlikely to be significantly affected by the proposed development.

- T17: M10a is located immediately downslope of T17, with a polygon feature to the south-west. The track to the turbine will be floated to maintain any shallow hydrological flow paths in this area. The contributing groundwater flow will be upgradient of the M10a community where the water is emergent. T17 is located approximately 50 m to the north-east of the polygon habitat, and slightly upgradient of the M10a community. It is not considered to be within the main zone of contribution of either feature. As the turbine excavation and subsequent hardstanding, does not provide a linear barrier to flow (in the way that an access track might), shallow groundwater flows in the wider area would also still be able to move around the excavation to areas downslope. Consequently, the turbine hardstanding is not considered to have a significant effect on the quantity of water reaching this point source.
- T21: M32a and M10a are located approximately 120 m downslope from T21. The turbine is located upgradient of the habitats and potentially within the wider zone of contribution. The turbine excavation and subsequent hardstanding, does not introduce a linear barrier to the wider movement of groundwater downslope and is not considered to have a significant effect on the quantity of water reaching the point source. However to minimise any potential impact, cut-off drains would be designed around turbine bases to ensure flows upslope are discharged diffusely downslope. Habitat monitoring should also be undertaken pre, during and post construction of the borrow pit, to check if these habitats are drying out and trigger mitigation if required. Monitoring requirements would be stated in the CEMP. It is noted that the habitats are out-with 100 m of the associated access track to the turbine.
- T24: T24 is located approximately 150 m downslope of the M32a habitat and therefore out-with the predominant zone of contribution to the habitat. The predominant zone of contribution to the groundwater point will be upgradient of the habitat, therefore upgradient of the infrastructure, and as such is not considered to be significantly affected by T24.
- T26: Whilst T26 is adjacent to an area of Highly Sub-dominant habitat, the infrastructure is to the south-east whilst the zone of contribution appears to from higher land to the south-west. It is therefore not assessed as having a significant effect flows to this habitat.
- T35: T35 is located approximately 110 m downslope of the M32a habitat and therefore out-with the predominant zone of contribution to the habitat. The predominant zone of contribution to the groundwater point will be upgradient of the habitat, therefore upgradient of the infrastructure, and as such is not considered to be significantly affected by T35.
- T39: Located approximately 160 m to the west along the contour from an area of M32a. Despite the proximity, the turbine location does not appear to be within the predominant flow path with no GWDTE habitats indicating shallow groundwater between the turbine and the spring. Give the above, it is considered that the turbine will not have a significant effect on any localised groundwater flows in this area.

The design has aimed to avoid GWDTE buffers where possible within the site constraints. Where some encroachment into the buffer has occurred that is within the potential zone of contribution, it would be mitigated through:

- Floating access tracks, or cross drains where the access track cannot be floated for engineering reason; and

- Cut-off drains around turbines foundations.

Habitat monitoring has been proposed downgradient of T21 and the borrow pit search area adjacent to T7 (should the borrow pit be progressed). This approach would provide a management tool to trigger further mitigation if required.

ANNEX E. SEPA CORRESPONDENCE ON GWDTE

The following letters document the correspondence between MacArthur Green and SEPA on GWDTE within the NVC study area, specifically the re-classification of M16d as not being a highly dependent GWDTE. This Annex includes the following:

- MacArthur Green letter to SEPA dated 01 December 2017
- SEPA response letter dated 19 December 2017
- Second MacArthur Green letter to SEPA dated 20 February 2018
- Second SEPA response letter dated 27 February 2018
- MacArthur Green email dated 19 June 2018
- SEPA response letter dated 18 July 2018

MacArthur Green

Susan Haslam
Scottish Environment Protection Agency
By email only to: susan.haslam@sepa.org.uk

95 South Woodside Road
Glasgow
G20 6NT

Date: 01 December 2017

Glenshero Wind Farm, Pre-Application Information: Groundwater Dependant Terrestrial Ecosystems (GWDTE)

Dear Susan,

This letter provides pre-application information on the assessment of Groundwater Dependant Terrestrial Ecosystems (GWDTE), at the site of the proposed Glenshero Wind Farm development.

An NVC survey was completed in 2017 to support the Environmental Impact Assessment for the proposed development. The survey covered a rounded off 300 m buffer (joining the outer most points of the 300m buffer to create a coherent NVC Study Area) around a provision turbine layout (250 m maximum survey requirement, plus a 50 m micro-siting allowance) (Refer to Figure 1a and 1b in Annex 1).

NVC communities have been mapped as GWDTE based on Appendix 4 of SEPA's Land Use Planning System (LUPS) Guidance Note 31 (September, 2017). The results of the survey are shown in Figure 1a and 1b within Annex 1 to this letter.

Highly Dependent Groundwater Ecosystems

The Highly Dependent GWDTEs identified in the Study Area have been reviewed. The dominant NVC community within nearly all the Highly Dependent polygons is recorded as M16d (Wet Dwarf Shrub Heath).

SEPA's LUPS-31 Guidance states that M16 could be highly dependent on groundwater, dependent on the hydrogeological setting.

Hydrogeological Setting

The Study Area is located at high altitude (approximately 800 m AOD) and on a hydrological watershed. The underlying aquifer is stated to be of low productivity[1] with only small amounts of groundwater, generally found in the near surface weathered zone and in secondary fractures (evident as rare springs). It is therefore considered unlikely that there are notable areas of groundwater fed habitats in this hydrogeological setting.

There are areas of standing water on the plateau, at the watershed. This environment is believed to be driven predominantly by high levels of rainfall, low infiltration rates and low rates of evaporation.

[1] British Geological Survey, Onshore GeoIndex (http://mapapps2.bgs.ac.uk/geoindex/home.html), accessed November 2017.

M16d Community Erica tetralix – Sphagnum compactum wet heath - Juncus squarrosus – Dicranum scoparium sub-community

The M16d community has also been considered in further detail, with reference to the NVC Field Guide to Mires and Heaths[2]. This wet heath community is found on acid and oligotrophic mineral soils or shallow peats that are at least seasonally water logged.

It is stated in this guide that in the south of England, this habitat is characteristic of valley locations maintained by groundwater. However, in northern England, Wales and Scotland it is found on thin ombrogenous i.e. rainfall-fed peat, located at high altitudes.

The M16d community identified in the NVC survey for Glenshero Wind Farm, was found on thin peat and at high altitude. The low productivity aquifer and watershed location, supports our interpretation that this peatland is ombrogenous and is therefore rainfall fed rather than groundwater dependent.

GWDTE Assessment

Based on a review of the underlying aquifer and habitat characteristics, the M16d NVC community is not considered to be groundwater dependent in this hydrogeological setting. It is therefore proposed that the M16d NVC community is removed from the GWDTE assessment.

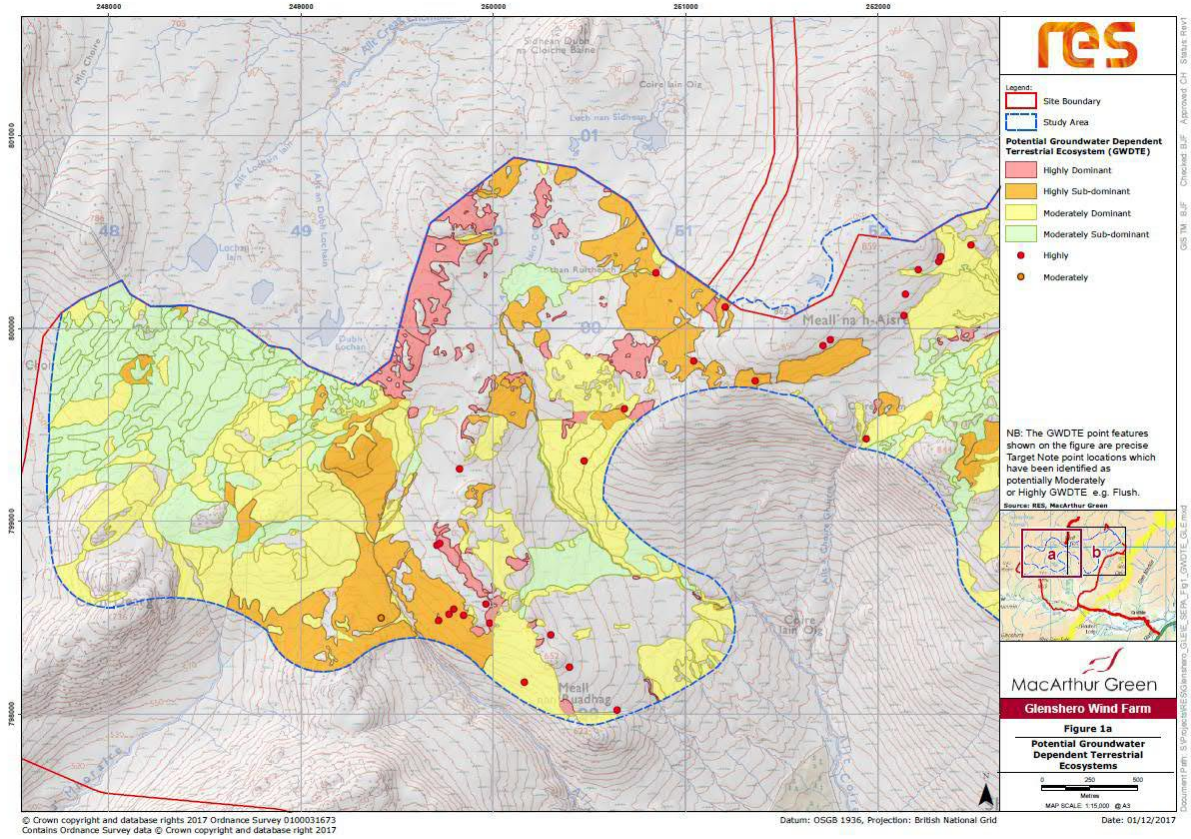
I would be grateful if SEPA could confirm their agreement with this approach. I would be happy to discuss this with your further if that would be of help.

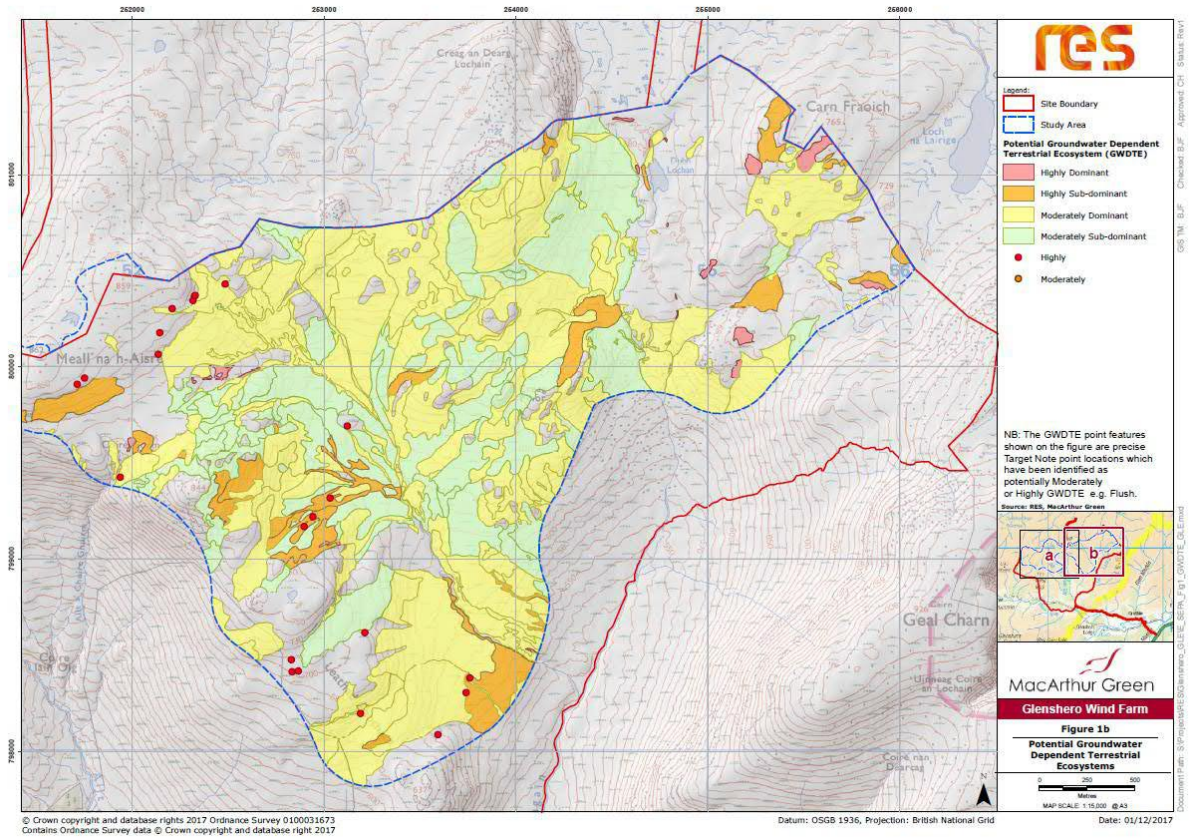
Yours sincerely,

David H. MacArthur
Principal Ecologist & Director

[2] Elkington, T., Dayton, N., Jackson, D.L., & Strachan, I.M., (2002), National Vegetation Classification field guide to mires and heaths, 120 pages softback, ISBN 1 86107 526 X

ANNEX 1. GWDTE SURVEY FIGURE





Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Our ref: PCS/156106
Your ref: ECU0000517

Nikki Anderson
The Scottish Government
Energy Consents Unit

If telephoning ask for:
Susan Haslam

19 December 2017

By email only to: Econsents_Admin@gov.scot

Dear Ms Anderson

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017
Proposed Glenshero Wind Farm Development
Land 3730M NW of 1 Garvamore, Laggan

Thank you for consulting SEPA on the scoping opinion for the above development proposal by your email received on 24 November 2017. We also received consultation direct from the developer's consultants on 1 December 2017 and we have used the information within that submission to provide the following overall advice.

We welcome the active engagement undertaken by the developer and his team to date and would encourage this to continue. As outlined at the start of the appendix, we would welcome the opportunity to comment on the main aspects of the EIA Report (EIAR) that we have a specific interest in, for example in relation to impacts on watercourses, peat and habitat management.

Advice to the determining authority

We consider that the following key issues must be addressed in the Environmental Impact Assessment process. To **avoid delay and potential objection,** the information outlined below and in the attached appendix must be submitted in support of the application.

a) Map and assessment of all engineering activities in or impacting on the water environment including proposed buffers, details of any flood risk assessment and details of any related CAR applications.

b) Map and assessment of impacts upon Groundwater Dependent Terrestrial Ecosystems and buffers.

c) Map and assessment of impacts upon groundwater abstractions and buffers.

d) Peat depth survey and table detailing re-use proposals.

SEPA Dingwall Office
Graesser House, Fodderty Way,
Dingwall Business Park, Dingwall IV15 9XB
tel 01349 862021 fax 01349 863987
www.sepa.org.uk • customer enquiries 03000 99 66 99

e) Map and table detailing forest removal.

f) Map and site layout of borrow pits.

g) Schedule of mitigation including pollution prevention measures.

h) Borrow Pit Site Management Plan of pollution prevention measures.

i) Map of proposed surface water drainage layout.

j) Decommissioning statement.

Further details on these information requirements and the form in which they must be submitted can be found in the attached appendix. We also provide site specific comments in the following section which can help the developer focus the scope of the assessment.

1. Site specific comments

1.1 We are generally content that the scoping report addresses our requirements. We provide the following site specific comments on this development proposal, taking into consideration Figure 1.2.

1.2 The scheme should be designed to make use of as much existing tracks and other on-site infrastructure as possible. In this regards we understand that the main north-south access track is existing (or already has temporary permission) and if this is the case then we welcome the approach of making use of this. The EIAR should clarify its status and what works, if any, will be required to facilitate this development.

1.3 The indicative turbine layout seems to include a buffer of at least 50 m to watercourses; this is welcomed. Further consideration should be given to the track layout to ensure it is as short as possible, taking into consideration local sensitivities. T1 to T39 is a compact array and we would be looking for a similar arrangement for other areas of the site, rather than the large use of spurs currently proposed. Consideration should be given to, for example, the east side of the site bing accessed via Turbine 17, rather than from further north. We would welcome further engagement with layout proposals as the development progresses to ensure that we are content with the finalised proposal.

1.4 We welcome the submission of the peat probing information collected to date by the developer; this is very helpful. A good stage 1 probing exercise has been undertaken for most of the site and this shows that peat depth on site are generally shallow with pockets of deep peat. We are pleased to note that the indicative turbine locations avoid deep peat; the final layout should demonstrate how tracks and other infrastructure also takes this approach. The final submission should also include probing for all areas (the area around T4, T22, T24, T33 T40 have not been probed) and additional more detailed probing is required in any areas where development is proposed near or within deep peat (> 1m). We would be content for no further peat probing where existing results suggest the peat is shallow.

1.5 We encourage the developer to identify areas where degraded peatland could be restored as potential mitigation for peat disturbance. Plans and photographs of the areas should be provided along with basic principles of restoration, aims and objectives. These could be submitted as part of a draft Habitat Management Plan.

1.6 We very much welcome the developer consulting us with more detailed proposals on Groundwater Dependant Terrestrial Ecosystems (GWDTE) at this stage. The electronic map shared with us suggests that a good NVC survey has been carried out and this has identified a number of GWDTE habitats. This includes generally moderately groundwater dependant M15 habitats and generally highly groundwater dependant M16 habitats. The

developer has provided us with information on the underlying aquifer and habitats characteristics and has suggested that the M16 habitats are not significantly groundwater dependant in this setting. While we agree with the hydrological setting described by the developer groundwater, although limited in amount, is likely to be present within the weathered and fractures upper part of the bedrock aquifer. Therefore it cannot be excluded that this limited amount of groundwater is present in sufficient quantity to maintain GWDTE in the area. As a result at this stage we do not accept that the M16 habitat is not significantly groundwater dependant at this site. We would be happy to consider this issue again, if additional information is provided to suggest the habitats are not groundwater dependence but in its absence we would wish to see highly groundwater dependant habitats avoided and suitable mitigation measures put in place to minimise impacts on any moderately groundwater dependant habitats.

1.7 As long as watercourse crossings are bottomless culverts or traditional style bridges designed to accommodate the 1 in 200 year and other infrastructure is located well away from watercourses we do not foresee a need for detailed information on flood risk to be provided. This assessment could be scoped out, if the above commitment was repeated in the EIAR.

1.8 We can confirm that from our perspective an outlined Construction Environmental Management Plan need not be provided with the application. Instead we refer you to the requirements outlined in Pollution Prevention and Environmental Management section outlined below.

1.9 We would be very supportive of the proposals for enhancement measures suggested at the pre-application meeting we attended. We suggest consideration of the following and would be happy to provide more specific advice on this aspect after the developer has given it further consideration: (1) wetland habitat restoration, (2) peatland restoration, (3) removal or control on non-native species in the catchment and (4) any actions to improve Water Framework Directive water bodies.

Regulatory advice for the applicant

2. Regulatory requirements

2.1 Management of surplus peat or soils may require an exemption under The Waste Management Licensing (Scotland) Regulations 2011. Proposed crushing or screening will require a permit under The Pollution Prevention and Control (Scotland) Regulations 2012. Consider if other environmental licences may be required for any installations or processes.

2.2 You may need to apply for a construction site licence under CAR for water management across the whole construction site. These will apply to sites of 4ha or more in area, sites 5 km or more in length or sites which contain more than 1ha of ground on a slope of 25 degrees or more or which cross over 500m of ground on a slope of 25 degrees or more. It is recommended that you have pre-application discussions with a member of the regulatory team in your local SEPA office.

2.3 Details of regulatory requirements and good practice advice for the applicant can be found on the Regulations section of our website. If you are unable to find the advice you need for a specific regulatory matter, please contact a member of the regulations team in your local SEPA office at: 28 Perimeter Road, Pinefield, Elgin, IV30 6AF - Tel: 01343 547663.

Should you wish to discuss this letter please do not hesitate to contact me on 01349 860359 or planning.dingwall@sepa.org.uk.

Yours sincerely

Susan Haslam
Senior Planning Officer
Planning Service

ECopy to: Kate Lyon, Ramboll Environ, KLyon@ramboll.com; ken.McCorquodale@highland.gov.uk; david@macarthurgreen.com

Appendix 1: Detailed scoping requirements

This appendix sets out our scoping information requirements. There may be opportunities to scope out some of the issues below depending on the site. Evidence must be provided in the submission to support why an issue is not relevant for this site in order **to avoid delay and potential objection**.

If there is a delay between scoping and the submission of the application then please refer to our website for our latest information requirements as they are regularly updated; current best practice must be followed.

We would welcome the opportunity to comment on the draft submission. As we can process files of a maximum size of only 25MB the submission must be divided into appropriately named sections of less than 25MB each.

1. Site layout

1.1 All maps must be based on an adequate scale with which to assess the information. This could range from OS 1: 10,000 to a more detailed scale in more sensitive locations. Each of the maps below must detail all proposed upgraded, temporary and permanent site infrastructure. This includes all tracks, excavations, buildings, borrow pits, pipelines, cabling, site compounds, laydown areas, storage areas and any other built elements. Existing built infrastructure must be re-used or upgraded wherever possible. The layout should be designed to minimise the extent of new works on previously undisturbed ground. For example, a layout which makes use of lots of spurs or loops is unlikely to be acceptable. Cabling must be laid in ground already disturbed such as verges. A comparison of the environmental effects of alternative locations of infrastructure elements, such as tracks, may be required.

2. Engineering activities which may have adverse effects on the water environment

2.1 The site layout must be designed to avoid impacts upon the water environment. Where activities such as watercourse crossings, watercourse diversions or other engineering activities in or impacting on the water environment cannot be avoided then the submission must include justification of this and a map showing:

a) All proposed temporary or permanent infrastructure overlain with all lochs and watercourses.

b) A minimum buffer of 50m around each loch or watercourse. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse and drawings of what is proposed in terms of engineering works.

c) Detailed layout of all proposed mitigation including all cut off drains, location, number and size of settlement ponds.

2.2 If water abstractions or dewatering are proposed, a table of volumes and timings of groundwater abstractions and related mitigation measures must be provided.

2.3 Further advice and our best practice guidance are available within the water engineering section of our website. Guidance on the design of water crossings can be found in our Construction of River Crossings Good Practice Guide.

2.4 Refer to Appendix 2 of our Standing Advice for advice on flood risk. Watercourse crossings must be designed to accommodate the 0.5% Annual Exceedance Probability (AEP) flows, or information provided to justify smaller structures. If it is thought that the development

could result in an increased risk of flooding to a nearby receptor then a Flood Risk Assessment must be submitted in support of the planning application. Our Technical flood risk guidance for stakeholders outlines the information we require to be submitted as part of a Flood Risk Assessment. Please also refer to Controlled Activities Regulations (CAR) Flood Risk Standing Advice for Engineering, Discharge and Impoundment Activities.

3. Disturbance and re-use of excavated peat and other carbon rich soils

3.1 Scottish Planning Policy states (Paragraph 205) that "Where peat and other carbon rich soils are present, applicants must assess the likely effects of development on carbon dioxide (CO_2) emissions. Where peatland is drained or otherwise disturbed, there is liable to be a release of CO_2 to the atmosphere. Developments must aim to minimise this release."

3.2 The planning submission must a) demonstrate how the layout has been designed to minimise disturbance of peat and consequential release of CO_2 and b) outline the preventative/mitigation measures to avoid significant drying or oxidation of peat through, for example, the construction of access tracks, drainage channels, cable trenches, or the storage and re-use of excavated peat. There is often less environmental impact from localised temporary storage and reuse rather than movement to large central peat storage areas.

3.3 The submission must include:

a) A detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements (including peat storage areas) overlain to demonstrate how the development avoids areas of deep peat and other sensitive receptors such as Groundwater Dependent Terrestrial Ecosystems.

b) A table which details the quantities of acrotelmic, catotelmic and amorphous peat which will be excavated for each element and where it will be re-used during reinstatement. Details of the proposed widths and depths of peat to be re-used and how it will be kept wet permanently must be included.

3.4 To avoid delay and potential objection proposals must be in accordance with Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and Minimisation of Waste and our Developments on Peat and Off-Site uses of Waste Peat.

3.5 Dependent upon the volumes of peat likely to be encountered and the scale of the development, applicants must consider whether a full Peat Management Plan (as detailed in the above guidance) is required or whether the above information would be best submitted as part of the schedule of mitigation.

3.6 Please note we do not validate carbon balance assessments except where requested to by Scottish Government in exceptional circumstances. Our advice on the minimisation of peat disturbance and peatland restoration may need to be taken into account when you consider such assessments.

4. Disruption to Groundwater Dependent Terrestrial Ecosystems (GWDTE)

4.1 GWDTE are protected under the Water Framework Directive and therefore the layout and design of the development must avoid impact on such areas. The following information must be included in the submission:

a) A map demonstrating that all GWDTE are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the

distances require it.

b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all GWDTE affected.

4.2 Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice and the minimum information we require to be submitted.

5. Existing groundwater abstractions

5.1 Excavations and other construction works can disrupt groundwater flow and impact on existing groundwater abstractions. The submission must include:

a) A map demonstrating that all existing groundwater abstractions are outwith a 100m radius of all excavations shallower than 1m and outwith 250m of all excavations deeper than 1m and proposed groundwater abstractions. If micro-siting is to be considered as a mitigation measure the distance of survey needs to be extended by the proposed maximum extent of micro-siting. The survey needs to extend beyond the site boundary where the distances require it.

b) If the minimum buffers above cannot be achieved, a detailed site specific qualitative and/or quantitative risk assessment will be required. We are likely to seek conditions securing appropriate mitigation for all existing groundwater abstractions affected.

5.2 Please refer to Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice on the minimum information we require to be submitted.

6. Forest removal and forest waste

6.1 Key holing must be used wherever possible as large scale felling can result in large amounts of waste material and in a peak release of nutrients which can affect local water quality. The supporting information should refer to the current Forest Plan if one exists and measures should comply with the Plan where possible.

6.2 Clear felling may be acceptable only in cases where planting took place on deep peat and it is proposed through a Habitat Management Plan to reinstate peat-forming habitats. The submission must include:

a) A map demarcating the areas to be subject to different felling techniques.

b) Photography of general timber condition in each of these areas.

c) A table of approximate volumes of timber which will be removed from site and volumes, sizes of chips or brash and depths that will be re-used on site.

d) A plan showing how and where any timber residues will be re-used for ecological benefit within that area, supported by a Habitat Management Plan. Further guidance on this can be found in Use of Trees Cleared to Facilitate Development on Afforested Land – Joint Guidance from SEPA, SNH and FCS.

7. Borrow pits

7.1 Scottish Planning Policy states (Paragraph 243) that “Borrow pits should only be permitted if there are significant environmental or economic benefits compared to obtaining material from local quarries, they are time-limited; tied to a particular project and appropriate reclamation measures are in place.” The submission must provide sufficient information to

address this policy statement.

7.2 In accordance with Paragraphs 52 to 57 of Planning Advice Note 50 Controlling the Environmental Effects of Surface Mineral Workings (PAN 50) a Site Management Plan should be submitted in support of any application. The following information should also be submitted for each borrow pit:

a) A map showing the location, size, depths and dimensions.

b) A map showing any stocks of rock, overburden, soils and temporary and permanent infrastructure including tracks, buildings, oil storage, pipes and drainage, overlain with all lochs and watercourses to a distance of 250 metres. You need to demonstrate that a site specific proportionate buffer can be achieved. On this map, a site-specific buffer must be drawn around each loch or watercourse proportionate to the depth of excavations and at least 10m from access tracks. If this minimum buffer cannot be achieved each breach must be numbered on a plan with an associated photograph of the location, dimensions of the loch or watercourse, drawings of what is proposed in terms of engineering works.

c) You need to provide a justification for the proposed location of borrow pits and evidence of the suitability of the material to be excavated for the proposed use, including any risk of pollution caused by degradation of the rock.

d) A ground investigation report giving existing seasonally highest water table including sections showing the maximum area, depth and profile of working in relation to the water table.

e) A site map showing cut-off drains, silt management devices and settlement lagoons to manage surface water and dewatering discharge. Cut-off drains must be installed to maximise diversion of water from entering quarry works.

f) A site map showing proposed water abstractions with details of the volumes and timings of abstractions.

g) A site map showing the location of pollution prevention measures such as spill kits, oil interceptors, drainage associated with welfare facilities, recycling and bin storage and vehicle washing areas. The drawing notes should include a commitment to check these daily.

h) A site map showing where soils and overburden will be stored including details of the heights and dimensions of each store, how long the material will be stored for and how soils will be kept fit for restoration purposes. Where the development will result in the disturbance of peat or other carbon rich soils then the submission must also include a detailed map of peat depths (this must be to full depth and follow the survey requirement of the Scottish Government's Guidance on Developments on Peatland - Peatland Survey (2017)) with all the built elements and excavation areas overlain so it can clearly be seen how the development minimises disturbance of peat and the consequential release of CO_2.

i) Sections and plans detailing how restoration will be progressed including the phasing, profiles, depths and types of material to be used.

j) Details of how the rock will be processed in order to produce a grade of rock that will not cause siltation problems during its end use on tracks, trenches and other hardstanding.

8. Pollution prevention and environmental management

8.1 One of our key interests in relation to developments is pollution prevention measures during the periods of construction, operation, maintenance, demolition and restoration. A schedule of mitigation supported by the above site specific maps and plans must be submitted. These must include reference to best practice pollution prevention and construction techniques (for example, the maximum area to be stripped of soils at any one time) and regulatory requirements. They should set out the daily responsibilities of ECOWs, how site inspections will be recorded and acted upon and proposals for a planning monitoring enforcement officer. Please refer to Guidance for Pollution Prevention (GPPs).

9. Life extension, repowering and decommissioning

9.1 Proposals for life extension, repowering and/or decommissioning must demonstrate accordance with SEPA Guidance on the life extension and decommissioning of onshore wind farms. Table 1 of the guidance provides a hierarchical framework of environmental impact based upon the principles of sustainable resource use, effective mitigation of environmental risk (including climate change) and optimisation of long term ecological restoration. The submission must demonstrate how the hierarchy of environmental impact has been applied, within the context of latest knowledge and best practice, including justification for not selecting lower impact options when life extension is not proposed.

9.2 The submission needs to demonstrate that there will be no discarding of materials that are likely to be classified as waste as any such proposals would be unacceptable under waste management licensing. Further guidance on this may be found in the document Is it waste - Understanding the definition of waste.

MacArthur Green

Susan Haslam
Scottish Environment Protection Agency
By email only to: susan.haslam@sepa.org.uk

95 South Woodside Road
Glasgow
G20 6NT

Date: 20 February 2018

RE: Glenshero Wind Farm, Pre-Application Information: Groundwater Dependent Terrestrial Ecosystems (GWDTE)

Dear Susan,

Thank you for your recent response on the above matter within PCS/156106, dated 19 December 2017. This letter provides further pre-application information with regards site specific point 1.6 in your response, noted below for ease of reference.

"*We very much welcome the developer consulting us with more detailed proposals on Groundwater Dependent Terrestrial Ecosystems (GWDTE) at this stage. The electronic map shared with us suggests that a good NVC survey has been carried out and this has identified a number of GWDTE habitats. This includes generally moderately groundwater dependent M15 habitats and generally highly groundwater dependent M16 habitats. The developer has provided us with information on the underlying aquifer and habitats characteristics and has suggested that the M16 habitats are not significantly groundwater dependent in this setting. While we agree with the hydrological setting described by the developer groundwater, although limited in amount, is likely to be present within the weathered and fractures upper part of the bedrock aquifer. Therefore it cannot be excluded that this limited amount of groundwater is present in sufficient quantity to maintain GWDTE in the area. As a result at this stage we do not accept that the M16 habitat is not significantly groundwater dependent at this site. We would be happy to consider this issue again, if additional information is provided to suggest the habitats are not groundwater dependence but in its absence we would wish to see highly groundwater dependent habitats avoided and suitable mitigation measures put in place to minimise impacts on any moderately groundwater dependent habitats*".

Due to the importance of high dependency GWDTEs to the layout of the wind farm we are keen to discuss and agree the approach with SEPA in advance of the layout being finalised. This letter particularly relates to the requested further assessment of M16 communities as potential highly GWDTE; however, reference is also made to a number of other potential GWDTE at the site as this provides useful additional context.

A detailed preliminary GWDTE sensitivity assessment based on various items of site-specific data and information is provided within Appendix 1 to this letter for your review. In summary this appraisal has revealed:

- The presence of four potentially high GWDTE communities within the study area: M6, M10, M32, and M16d.
- M10 flushes and M32 springs are considered to be GWDTE by their nature; as habitats that depend on a supply of, or irrigation by, groundwater.
- M6 has the potential to be influenced, at least partially, by groundwater.

- M16d wet heath in the study area is very unlikely to be 'highly' groundwater dependent, and instead is likely to have either no or 'low' dependency on groundwater.

Our view that M16d is not a high GWDTE at the site is based on the following reasons (discussed in detail in Appendix 1):

- The high-altitude nature of the site and its presence on a hydrological watershed.
- Low productivity underlying aquifer with only small amounts of groundwater found in the near surface weathered zone and in secondary fractures.
- The very small potential zones of groundwater contribution or sub-catchments upslope of areas of M16d.
- Input of water to maintain the conditions for wet heath on site appears most likely from direct precipitation.
- The near ubiquitous covering of high-altitude acid peat across the site.
- The species-poor floristics and relatively dry nature of the site stands and their similarity, overlap and transitions with M15 wet heath.
- The lack of any species within the areas of M16d that could indicate a degree of flushing or base-rich input from groundwater.

We believe the information provided in Appendix 1 supports our interpretation that M16d peatland at this site is ombrogenous and rainfall-fed rather than highly groundwater dependent.

If in some areas there is an input of groundwater to areas of M16d then we consider it to be of very low volume and of negligible significance in maintaining the necessary wetness of the habitat type. Even if M16 at the site is thus considered to have a 'low' dependency on groundwater then the areas of M16d will be treated in the same regards as the potentially moderately dependent M15 wet heath, whereby suitable mitigation measures will be put in place to minimise hydrological impacts on these habitats.

It is therefore proposed that M16d is not considered a high GWDTE at the site and as such is treated in the same regards as M15 wet heath.

I would be happy to discuss this with you or SEPA's wetland ecologist further if that would be of help.

Yours sincerely,

Brian Henry
Senior Ecologist

APPENDIX 1: PRELIMINARY GWDTE ANALYSIS FOR GLENSHERO

Potential High GWDTEs Recorded

NVC surveys undertaken at the site recorded four communities classed as potentially high GWDTEs based on Appendix 4 of SEPA's Land Use Planning System (LUPS) Guidance Note 31 (September, 2017). These communities being M6 *Carex echinata – Sphagnum fallax/denticulatum* mire, M10 *Carex dioica - Pinguicula vulgaris* mire, M16d *Erica tetralix – Sphagnum compactum* wet heath and M32 *Philonotis fontana – Saxifraga stellaris* spring.

Of these communities M6 and M10 are small flush features, generally too small to map as discrete stands of vegetation and are therefore included as percentages within areas mapped as mosaics of vegetation. M32 occurs as infrequent small springs and associated rills through some sections of the site, the locations of M32 were target noted to provide exact locations of these features. However, the vast majority of areas mapped as potentially high GWDTE are areas of the M16d *Erica tetralix – Sphagnum compactum* wet heath, *Juncus squarrosus – Dicranum scoparium* sub-community.

M32 *Philonotis fontana – Saxifraga stellaris* spring

M32 springs are **considered to be GWDTE features**, these springs and rills contain a slightly more basiphilous flora than would be expected in such an upland acid environment, and by definition this community is dependent on sustained irrigation by groundwater; although these groundwaters are circumneutral rather than truly base-rich, and can be found over a wide variety of rock types[1,2]. On site these springs generally appear in mid-slope areas and are likely a result of secondary fractures in the underlying strata. All examples within the site are of the M32a *Sphagnum denticulatum* sub-community; this has an impoverished vascular flora, and is dominated by mounds of *S. denticulatum*, this sub-community occurs mainly on the harder acidic quartzites and sandstones of the Highlands[1].

M10 *Carex dioica - Pinguicula vulgaris* mire

Areas of M10 flushing are also **considered to be GWDTE features**. M10 is a soligenous mire of mineral soils and shallow peats kept wet by base-rich, calcareous and oligotrophic waters[1,2]. The community includes a range of distinctive calcicolous flush vegetation. The community can occur wherever there is flushing with base-rich water, either below a springhead or where water emerges more diffusely from the ground, most stands being constantly irrigated[3]. At the site, as well as areas of more diffuse seepage on slopes there are a number of M10 flushes that sit directly below and are fed by M32 springheads. All areas of M10 within the site were recorded as the M10a *Carex viridula - Juncus bulbosus/kochii* sub-community. M10a is the least calcicolous form of M10[1], which can be seen through the sward on site also including more characteristically acid species such as *Narthecium ossifragum*, *Erica tetralix*, *Trichophorum germanicum*, *Drosera rotundifolia*, *Eriophorum angustifolium*, *Carex viridula* and *C. echinata*.

M6 *Carex echinata – Sphagnum fallax/denticulatum* mire

Stands of M6 have the **potential to be influenced, at least partially, by groundwater**. However, from experience, many tend to be rainwater-fed features which are part of wider ombrogenous mire ecosystems. M6 is generally a soligenous community of peats and peaty gleys irrigated by base poor waters in the sub-montane zone. The community is composed of small sedges or rushes dominating

[1] Rodwell, J.S. (Ed) et al. (1991). *British Plant Communities Volume 2 Mires and Heaths*. Cambridge University Press, Cambridge.

[2] Elkington, T., Dayton, N., Jackson, D.L., & Strachan, I.M. (2001). *National Vegetation Classification: Field guide to mires and heaths.* ISBN 1 86107 526 X.

[3] Averis, A., Averis, B., Birks, J., Horsfield, D., Thompson, D., & Yeo, M. (2004). *An Illustrated Guide to British Upland Vegetation.* JNCC, Peterborough. ISBN 1 86107 553 7.

over a carpet of oligotrophic and base-intolerant Sphagna[1,2]. Given the more montane nature of the site, the extent of M6 is very limited within the area surveyed; present mostly as small flushes, runnels or soakways, and along minor watercourses.

M16 *Erica tetralix – Sphagnum compactum* wet heath

The majority of site areas mapped as potentially high GWDTE are patches of the M16d *Erica tetralix – Sphagnum compactum* wet heath, *Juncus squarrosus – Dicranum scoparium* sub-community. This wet heath community is found on acid and oligotrophic mineral soils or shallow peats that are moist and at least seasonally waterlogged; it can, more rarely, also be found on the thin margins of blanket bogs[1]. M16 typically occurs on sloping ground, although it can cover almost level ground too. In Scotland it extends onto thin ombrogenous (i.e. rainfall-fed) peats at higher altitudes[1].

SEPA's LUPS-31 Guidance states that M16 could be highly dependent on groundwater, dependent on the hydrogeological setting. However, we believe the species poor sub-community M16d present at the site is not highly groundwater dependent based on the NVC data collected, community floristics, site notes and characteristics, and the initial appraisal of the hydrogeological setting (as eluded to in our original letter). Our reasons for this view are set out below, and are based on a number of different pieces of site specific evidence.

Hydrogeological Setting

As stated previously, the survey area is located at high altitude (approximately 800m AOD) and on a hydrological watershed. The underlying aquifer is stated to be of low productivity[4] with only small amounts of groundwater, generally found in the near surface weathered zone and in secondary fractures (evident as rare springs – e.g. see presence and information on M32a springs described above). It is therefore considered unlikely that there are notable areas of groundwater fed habitats in this hydrogeological setting.

There are areas of standing water on the plateau, at the watershed. The vegetation communities in this environment are therefore believed to be influenced predominantly by high levels of rainfall, late lying snow, low infiltration rates and low rates of evaporation.

Site Specific Setting of M16d

M16d is scattered throughout the study area, though it never forms large stands and tends to be found in small scattered fragments of habitat. It is found in the more elevated areas of ground on moderately steep to flatter slopes over thin and damp, often stony or rocky peats/wet peaty soils where the rocky substrate is quite often exposed in places. The site-specific occurrence of M16d within the site follows a very consistent pattern throughout. It generally can be seen on site bridging many intervening gaps on the slopes between the dry and montane dry heaths on the rocky knolls and ridges upslope (NVC types H12/H13/H14), through to the deeper peats of areas of degraded blanket bog in the flatter areas and basins below (NVC types M17 & M19). Also, this sloping wet heath zone, more often than not, contains the commoner and more prevalent in Scotland M15 *Trichophorum germanicum – Erica tetralix* form of wet heath (a potentially moderate GWDTE), and in which M16d often forms mosaics and is difficult to separate transitions with. In this upland Scottish context, these two wet heath types are very similar and differences between them are often subtle and difficult to define or discern in the field (discussed further below in the botanical assessment).

[4] British Geological Survey, Onshore GeoIndex (http://mapapps2.bgs.ac.uk/geoindex/home.html), accessed November 2017.

Qualitative topographical observations during field surveys indicate that these areas of M16d below small knolls or rocky outcrops, or on the slopes below ridges, below mostly montane heaths, have very small potential zones of groundwater contribution or sub-catchments from upslope or above. It was considered that these small and localised potential sources of groundwater from the near surface weathered zone (as per the hydrological appraisal above) would not provide sufficient groundwater input or throughflow to maintain a M16 (or even M15) wet heath community in isolation, if indeed they provide any groundwater at all. The input of water to maintain the wet heath on site is most likely from rainfall. From these observations alone, it was considered that M16 was very unlikely to be a highly GWDTE at the site.

Presence of Peat

A Phase 1 peat depth survey has been conducted across the study area on a 100m grid (n = 1128 sample points). Peat or peaty soils[5] cover virtually all of the study area; only 11 points were recorded as having no peat/peaty soil present, and these were noted over exposed bedrock, rather than other mineral soils. As would be expected with such an extensive upland site and the variable topography, there is considerable variation in peat depth. However, the site overall is generally quite shallow, with some obvious deeper pockets. Peat/peaty soil depths range from 2cm to 352cm, with a mean of 90cm.

Chart 1 shows that peat depths across the site are relatively normally distributed; with 41% of sample locations having a depth of less than 0.5m. Areas with a peat depth of over 0.5m are considered to be ombrogenous and rainfall-fed habitats (and therefore not GWDTE). Therefore, any areas of M16d on peat over 0.5m would not be considered a potential GWDTE. However, much M16d does fall on areas with less than 0.5m of peat/peaty soil. Despite this, the near ubiquitous covering of peat across the site, even where it is less than 0.5m in depth, would again suggest the majority of wetland habitats across the site as a whole (including M16) are part of a larger predominately ombrogenous ecosystem or complex.

As noted in Rodwell et al[1], M16 occurs on acid peat/soils where the surface pH typically lies between 3.5-4.5. This ecological niche for the development of M16 on raw acid peat would again indicate the peatland habitats on site are acid and as such it is likely that much of this acidity comes from the high rainfall – low evaporation (i.e. ombrogenous) upland environment and suggests a lack of minetrophic or base-rich input, that would need to come from groundwater in this location.

[5] i.e. highly organic or peaty soils under 0.5m in depth.

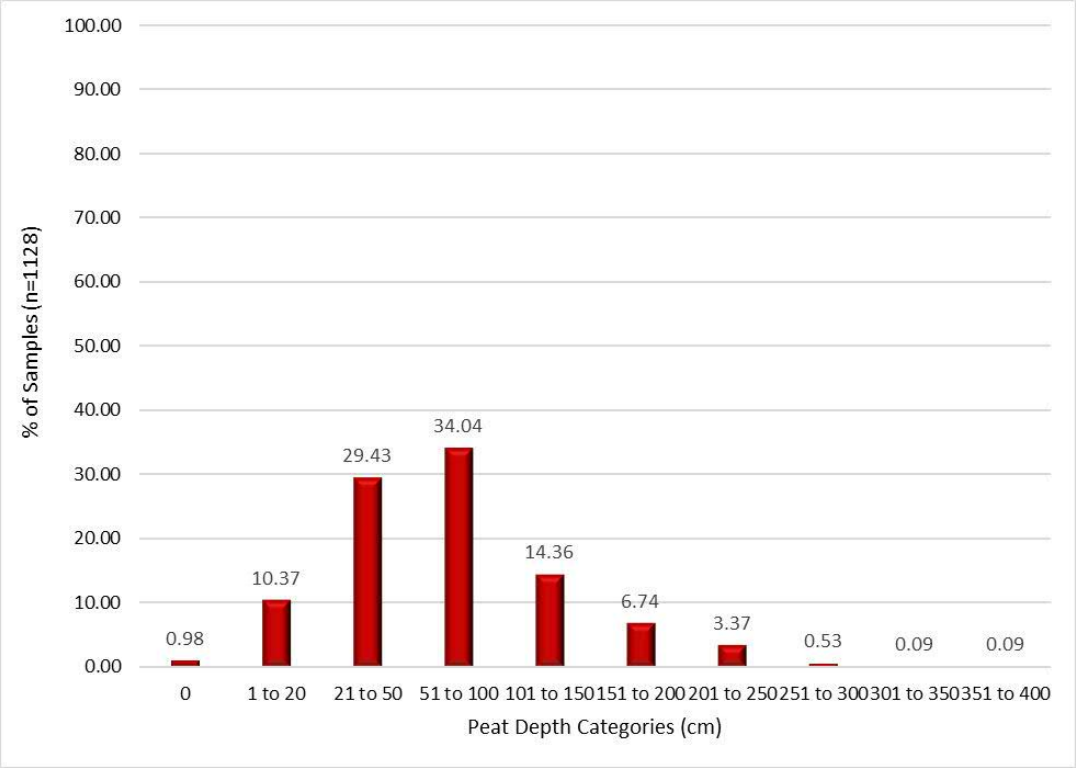


Chart 1: Peat depth histogram

Botanical Assessment of Site M16d

This section provides an in-depth perspective on the floristics, quality and character of the M16d *Juncus squarrosus - Dicranum scoparium* sub-community at the site gained from the field surveys and associated data collected, within the wider context of M16 as a mainland UK habitat type.

M16 in a UK context

As described in Rodwell et al[1], M16 in Great Britain is a wet heath that occurs on acid soils which are too dry for the development of blanket mire and too wet for the development of *Calluna*-based dry heaths. The soils need to be maintained in a moist state for the majority of the year. The M16 community as a whole is dominated by mixtures of three main constituent vascular species; i.e. *Erica tetralix*, *Calluna vulgaris* and *Molinia caerulea*. However, their proportions are very variable, being influenced by differences in the water regime and trophic state of the soils (there is considerable variations amongst the four M16 sub-communities also).

M16d is the usual form of this heath in Scotland and it is notably different from the other sub-communities in the comparative frequency and abundance of these defining species. In general, within M16d *Erica tetralix* becomes much sparser and *Calluna* becomes the overall dominant species. *Molinia* becomes rare and is often absent, whereas *Trichophorum germanicum* and *Juncus squarrosus* become abundant and distinctive in this sub-community. M16d is the driest form of this heath type, as Sphagna become sparse and patchy and are instead replaced with a higher abundance of non-*Sphagnum* mosses and, in particular, lichens. The dryness of M16d is also reflected in the relative abundances of the main vascular species, most notably the decrease in the damper conditions favouring *Erica tetralix* and the increase in *Calluna* abundance and vigour; which is often a result of there being less soil waterlogging in these stands, with more fluctuations in moisture content or the presence of a consistently lower water-table (severe waterlogging would lead to *Calluna* root failure).

Stands of M16d in Scotland also commonly contain some *Eriophorum angustifolium*, *Narthecium ossifragum* and *Potentilla erecta*. The presence of these particular additional species and their increased frequency in M16d is a feature of the floristic shift and transitions from M16d to M15 *Trichophorum germanicum – Erica tetralix* wet heath observed in moving into the uplands of Scotland. Such transitions are frequent, particularly on wet slopes with moderately thick ombrogenous peat. Indeed, Rodwell comments that the M16d sub-community "*can be seen as a transition to the [M15] Trichophorum – Erica wet heath, which replaces [M16] in the sub-montane north and west*".

M16d at the Site

The character of the areas of M16d surveyed are consistent throughout the study area, with a species-poor sward which is defined and generally characterised by co-dominant mixtures of *Calluna vulgaris* and *Trichophorum germanicum* with abundant and sometimes locally dominant *Juncus squarrosus* and *Eriophorum angustifolium*. In most areas there were few other vascular species, though *Empetrum nigrum* was frequent. Much more rarely, and only in some stands, were records for *Carex panicea*, *Molinia caerulea*, *Vaccinium myrtillus* and *Huperzia selago* and given the altitude of the study area, some stands also contained sparse *Carex bigelowii*. *Erica tetralix* was very rare, and for the most part absent.

The basal layer of the site stands is dominated by *Cladonia* spp. (lichens) and *Racomitrium lanuginosum*, with some pleurocarpous mosses such as *Pleurozium schreberi*. Sphagna are rare and patchy, and actually absent from most stands. Where present it tends to be *Sphagnum capillifolium* rather than *S. compactum* or *S. tenellum* as would be expected in M16 (as *S. capillifolium* is usually more indicative of M15); however, small patches of *S. compactum* were noted in some areas. The reasons for assigning these areas as M16d instead of M15 are discussed further below.

On occasions *Trichophorum germanicum* was the single main dominant species in the sward in these stands; this is a common occurrence in many upland heaths and results from the legacy of a long grazing history (by deer at this site) as more palatable species are grazed out to leave *T. germanicum*. In these *T. germanicum* heaths the other typical species such as *Calluna* are much reduced and sparse; other associated species tend to be present in small quantities. As has been discussed by Averis[6] this is essentially a non-NVC vegetation type as the dominance of *T. germanicum* can be confusing with regard to NVC classification, but the vegetation is in '*most cases*' referable to M15 (classifiable at community level or even specifically as sub-communities M15b, M15c or M15d depending on the associated species); however, where *Potentilla erecta* and/or *Sphagnum capillifolium* are very rare or absent and the vegetation noticeably species-poor, then M16 is considered a better fit[6]. Specifically, M16d is the closest fit for these wet heaths.

Given the information above on the species assemblage and floristics within areas mapped as M16d at the site and the character of wet heath communities from the literature, it was considered that these species-poor stands characterised by *Calluna*, *T. germanicum*, *Juncus squarrosus* and frequent *Eriophorum angustifolium* with few other species (noting absent or rare *Potentilla erecta*) along with a dry basal layer of lichens and *Racomitrium lanuginosum* and absent to rare patches of Sphagna were more appropriately classified as M16d rather than M15 (as per Averis[6]).

It should be noted that these areas mapped as M16d could well within reason also be classified as M15 depending on surveyor interpretation of the vegetation, the distinction between the communities with such a flora is not obvious or clear. As mentioned above M16d can be seen as a transition to M15 wet heath[1] and there is much overlap with the transitional boundaries between M16 and M15 at the site often blurred in a floristic continuum.

[6] Non-NVC vegetation types found by Ben and Alison Averis (09-09-2015).doc http://www.benandalisonaveris.co.uk/downloads_13.html

Additionally, the species-poor flora of M16d at the site contained no species that are indicative of, or associated with, flushing or some base-rich input which would need to come from groundwater (as can been seen in M15a or M16c for example).

Discounting M16d as a 'High' GWDTE

The detailed information above has been presented to provide SEPA with more detail on the site-specific conditions with regards potential GWDTE at the site, in particular our assessment of the likely groundwater dependency of M16. From our appraisal and knowledge of the site we believe that M16 at the site is not a high GWDTE for the following summary reasons:

- The high-altitude nature of the site and its presence on a hydrological watershed.
- Low productivity underlying aquifer with only small amounts of groundwater found in the near surface weathered zone and in secondary fractures.
- The very small potential zones of groundwater contribution or sub-catchments upslope of areas of M16. It is considered that these potential sources of groundwater from the near surface weathered zone would not provide sufficient groundwater input or throughflow to maintain M16 in isolation (if indeed they provide any groundwater at all).
- The input of water to maintain the conditions for wet heath on site appears most likely from direct precipitation.
- The near ubiquitous covering of high-altitude acid peat across the site, even where it is less than 0.5m in depth, would again suggest the majority of wetland habitats across the site as a whole (including M16) are part of a larger predominately rainfall-fed and ombrogenous ecosystem.
- The ecological niche for the development of M16 on acid peat with pH 3.5-4.5 would again indicate it is likely that much of this acidity comes from the high rainfall – low evaporation (i.e. ombrogenous) upland environment and suggests a lack of minetrophic or base-rich groundwater input.
- The species-poor floristics and relatively dry nature of the site stands (provided in detail above) and their similarity, overlap and transitions with M15 wet heath (in which M16 could feasibly be classified as M15 instead).
- The lack of any species within the areas of M16 that could indicate a degree of flushing or base-rich input from groundwater.

Overall, it is therefore considered very unlikely that there are notable areas of groundwater fed habitats at this site and within this particular hydrogeological setting, except for the sparse, small and very occasional occurrences of the M10a and M32a NVC communities.

We believe the information above supports our interpretation that M16 peatland at this site is ombrogenous and rainfall-fed rather than 'highly' groundwater dependent. If for any reason in some areas there is an input of groundwater to areas of M16 then we consider it to be of very low volume and of negligible significance in maintaining the necessary wetness of the habitat type. Even if M16 at the site is thus considered to have a 'low' dependency on groundwater then the areas of M16 will be treated in the same regards as the potentially moderately dependent M15 wet heath, whereby suitable mitigation measures will be put in place to minimise hydrological impacts on these habitats.

It is therefore proposed that M16d is not considered a high GWDTE at the site and as such is treated in the same regards as M15 wet heath.

Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Our ref: PCS/157675
Your ref: ECU0000517

Claire Hollingworth
MacArthur Green
Glasgow

If telephoning ask for:
Susan Haslam

By email only to: claire.hollingworth@macarthurgreen.com

27 February 2018

Dear Ms Hollingworth

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017
Proposed Glenshero Wind Farm Development
Land 3730M NW of 1 Garvamore, Laggan

Thank you for consulting SEPA further on your habitat assessment for the above site by way of your email of 20 February 2018. We welcome this continued engagement.

We have considered the further information in your letter and appendix 1 and are content that in this particular setting the M16d wet heath is unlikely to be highly groundwater dependant. We would therefore be content with an approach which avoided direct impacts where possible, but where not possible suitable mitigation measures (floating tracks, drainage etc) are put in place to protect surrounding habitats.

Please see our Guidance on Assessing the Impacts of Development Proposals on Groundwater Abstractions and Groundwater Dependent Terrestrial Ecosystems for further advice on GWDTE assessment.

Should you wish to discuss this letter please do not hesitate to contact me on 01349 860359 or planning.dingwall@sepa.org.uk.

Yours sincerely

Susan Haslam
Senior Planning Officer
Planning Service

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Claire Hollingworth

From: [redacted]
Sent: [redacted]
To: [redacted]
Cc: [redacted]
Subject: Glenshero GWDTE Results and Peat Probing Layout
Attachments: Userguide.docx; Logon Instructions.docx

Susan

Thank you again for agreeing to discuss the revised layout and surveyed GWDTE locations, and apologies for the slight lag getting back to you with the portal. I understand that further information was also required last week with regards to the proposed Phase 2 peat probing strategy and we thought it would be useful to load these layers into the same portal. They can be turned on / off as required but may be easier to review in this format.

The Glenshero portal is now active and contains the layers listed below. Login details are attached along with a user guide.

- Frozen design layout for the proposed Glenshero Wind Farm;
- Original NVC and GWDTE polygons and Target Notes for the central area of the site, including survey results for the previous pre-application discussion (MacArthur Green Pre-Application Information 20th February 2018). Areas of M16d have been down-graded to Moderate groundwater dependency as per M15 wet heath. This is following SEPA's pre-application response noting that in this setting, M16d is unlikely to be Highly groundwater dependent.
- Additional NVC and GWDTE polygons and Target Notes for areas of the site not previously surveyed;
- All peat depths as probed, full peat interpolation across the range of peat depths recorded, peat specifically between 0 - 0.5 m and 0.5 - 1 m in depth; and
- Phase 2 survey area (areas where peat is above 1 m plus a 50 m buffer around this) and the proposed Phase 2 survey points. Where infrastructure such as a borrow pit clips the survey area, the whole borrow pit has been included in the Phase 2 survey. Please note that the requirement to survey the gatehouse at the far north entrance is being reviewed as there are areas of existing hardstanding at this location.

A key difference in the latest layout is that the site will utilise the access track route through the existing Stronelairg Wind Farm, reducing the overall track requirement. A new access track will tie into the existing Stronelairg infrastructure and runs south to the proposed development.

The turbine layout has been designed to avoid areas of peat greater than 1 m in depth; the access track will need to cross some areas of peat greater than 1 m in depth but these areas have been kept to a minimum and will be floated where feasible.

The GWDTE results have not been clipped to 100 m / 250 m of the infrastructure and are shown across the whole study area for context. The design layout has aimed to avoid Highly dependent GWDTE, and, Moderate GWDTE where feasible. A number of Highly Dependent M10a and M32a springs and flushes have been recorded as Target Note point sources. These largely align with areas of High Sub-dominant GWDTE habitats. The layout has been designed around these areas, where feasible within the other constraints of the site.

In addition to the Phase 2 probing strategy, we would like to discuss the following key areas with SEPA pre-application:

- East – West linking access track: the access track is within 100 m of M10a and M32a Target Notes. It can also be seen from the aerial imagery that these are areas of emergent water; not all areas may be dependent only on groundwater due to the location close to the watershed and may be in part driven by rainfall and late lying snow.

  The design of the access track is being reviewed to assess the feasibility of floating this stretch of track. As this is a low productivity aquifer, high in the catchment it is likely that groundwater is focused to near surface weathered bedrock or fractures. The water is generally emergent upslope of the access track, with limited GWDTE habitats downslope that the access track may disconnect. If the track cannot be floated, it is proposed that a number of cross drains are constructed where there are downslope GWDTE present, to maintain the hydrological connectivity across this area of the access track.

- T39: Located approximately 140 m to the west along the contour from an area of M32a. Despite the proximity, the turbine location does not appear to be within the predominant flow path with no GWDTE habitats indicating shallow groundwater between the turbine and the spring. Give the above, it is considered that the turbine will not have a significant effect on any localised groundwater flows in this area.

- T17: M10a is located immediately downslope of T17. The feasibility of floating the track to T17 will be considered to maintain any shallow hydrological flow paths in this area. The contributing groundwater flow will be upgradient of the M10a community where the water is emergent. T17 is located approximately 50 m to the south-west of the habitat, slightly upgradient. It is not considered to be within the main zone of contribution. As the turbine excavation and subsequent hardstanding, does not provide a linear barrier to flow (in the way that a track might), shallow groundwater flows in the wider area will also still be able to move around the excavation to areas downslope. Consequently, the turbine hardstanding is not considered to have a significant effect on the quantity of water reaching this point source.

- T21: M32a and M10a are located approximately 120 m downslope from T21. The turbine is located upgradient of the habitats and potentially within the wider zone of contribution. As noted above, the turbine excavation and subsequent hardstanding, does not introduce a linear barrier to the wider movement of groundwater downslope. The turbine hardstanding is not considered to have a significant effect on the quantity of water reaching the point source. It is noted that the habitats are out-with 100 m of the associated access track to the turbine.

- T24: T24 is located approximately 150 m downslope of the M32a habitat and therefore out-with the predominant zone of contribution to the habitat. The predominant zone of contribution to the groundwater point will be upgradient of the habitat, therefore upgradient of the infrastructure, and as such is not considered to be significantly affected by T24.

- T35: T35 is located approximately 110 m downslope of the M32a habitat and therefore out-with the predominant zone of contribution to the habitat. The predominant zone of contribution to the groundwater point will be upgradient of the habitat, therefore upgradient of the infrastructure, and as such is not considered to be significantly affected by T35.

The assessment has focused to Highly dependent GWDTE polygons and point sources as the wider groundwater is considered to be of low productivity. Focussed areas of highly dependent GWDTE align with localised fractures or near surface weathered bedrock, and mitigation is being considered where the infrastructure may pose a significant effect to the groundwater flow.

Due to the overall low productivity of the underlying aquifer, dewatering of the turbines noted above is not considered to have a significant effect for the proposed development. This is based on the assessment that the wider groundwater body is low yielding, and notable groundwater would only be present if the excavation dissected a localised area of weathered bedrock or fracture.

Ground investigations should be completed prior to construction to increase confidence in this assumption. Should the investigation identifying localised springs which would require dewatering; habitats would be assessed on a site specific basis.

I hope the above information provides a context for the GWDTE assessment. Do let me know when you would like to discuss this further.

Kind Regards

Claire

Claire Hollingworth
Senior Hydrologist

[redacted]

[redacted]

MacArthur Green

Scottish Environment Protection Agency
Buidheann Dìon Àrainneachd na h-Alba

Our ref: PCS/159636
Your ref: ECU0000517

If telephoning ask for:
Susan Haslam

18 July 2018

Claire Hollingworth
MacArthur Green
Glasgow

By email only to: claire.hollingworth@macarthurgreen.com

Dear Ms Hollingworth

The Electricity Works (Environmental Impact Assessment) (Scotland) Regulations 2017
Proposed Glenshero Wind Farm Development
Land 3730M NW of 1 Garvamore, Laggan

Thank you for consulting SEPA further on your habitat assessment for the above site by way of your email of 19 June 2018. As we have indicated previously, we welcome this continued engagement. We apologise for the delay in responding and thank you for your patience.

To confirm, we have previously agreed that in this particular setting the M16d wet heath is unlikely to be highly groundwater dependant and therefore we would be content with an approach which avoided direct impacts where possible, but where not possible suitable mitigation measures (floating tracks, drainage etc) are put in place to protect surrounding habitats.

Your most recently correspondence sought our agreement to your assessment of potential impacts on other GWDTE habitats and we provide our response to each element in turn below.

1. East – West link access track: The M32a spring/M10a basic flush at TN52 appears to be under the footprint of the track. Micro siting should be used to avoid or minimise direct impacts as much as possible. At locations where there are direct impacts then the design of the track should ensure that the volume of supply of groundwater to the flushes and spring is maintained. The proposal to either float or to incorporate a number of cross drains to ensure hydrological connectivity between up- and downslope of the track is in line with our expectations for mitigation in these circumstances.

2. T39: We are content with your assessment that groundwater supply to this spring is unlikely to be affected by turbine T39.

3. T17: We consider that the edge of the hardstanding may clip the groundwater flow pathway to the M10a habitat but is unlikely to make a significant difference to the flow of groundwater to it and as a result we are content with the layout.

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4. T21: The GWDTE habitats at TN46 and TN47 are downslope of the turbine T21 and associated hardstanding. We consider that it is possible that the infrastructure in this area could have an impact on these habitats. We are content that the layout does not have to be revised but we would look for, via planning condition, monitoring of the habitats during construction, with action required should the habitats show signs of drying out. If the turbine base or hardstanding is acting as a barrier to the water then mitigation could take the form of a cut off drain upslope of the infrastructure which then carries the water round to the downslope side of the infrastructure then discharges diffusely into the surface. If the access track is having an impact on the volume of water supplied then cross drains or other means of making the track permeable to groundwater may be appropriate mitigation.

5. T24: We are content with your assessment that the M32a will not be significantly affected by T24.

6. T35: We are content with your assessment that the M32a will not be significantly affected by T35.

In conclusion, we consider the layout currently put forward as acceptable in terms of impacts on GWDTE as long as suitable mitigation is put in place to minimise effects; this should be outlined in the EIA Report.

Should you wish to discuss this letter please do not hesitate to contact me on 01349 860359 or planning.dingwall@sepa.org.uk.

Yours sincerely

Susan Haslam
Senior Planning Officer
Planning Service