

QUADRAT Scotland Ltd

ENVIRONMENTAL IMPACT ASSESSMENT (HABITATS)
FOR PROPOSED WIND DEVELOPMENT AT
STRONAFIAN COMMUNITY WOODLAND

By Nikki Dayton
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SUMMARY

This report describes the results of a habitat survey at the site of a proposed community wind development at Stronafian, Glendaruel, Cowal. (Grid ref NS 017 842, centred)

The proposed scheme is for two turbines located on the open ground at the back of Cruach nam Mult.

The survey was carried out using a combination of National Vegetation Classification (NVC) and 'Phase 1' classification systems for vegetation communities. The survey was undertaken in June 2014 with an additional visit to check some features in August 2014. The survey covered all open areas within the area of search and extended to the edge of the dense conifer plantation that surrounded the site and along some rides as appropriate.

There are no national or international designations on the land surveyed. The following upland habitats are listed in Annex 1 of the EU Habitats Directive: blanket bog, European dry heaths, northern Atlantic wet heaths and alkaline fens. The following habitats were found within the survey area:

- Blanket bog
- Bog pools
- Wet heath
- Acid flush
- Marshy grassland
- Acid grassland
- Dry heath
- Conifer plantation

Blanket bog and wet heath

Most of area of search is dominated by felled and standing conifer plantation that was planted on old peatland habitat. Where it has been felled and along rides the dominant habitats are poor wet heath and *Molinia caerulea* dominated marshy grassland with areas of rush fen along drains and alongside natural watercourses.

To the north of the site is an extensive open area dominated by blanket bog habitat and wet heath with some deep hags and pools, although it has become rather degraded by sheep grazing, past burning and changes to surface water hydrology as a result of the surrounding conifer plantation.

Blanket bog is an Annex 1 habitat and BAP habitat of national priority, and is particularly sensitive to development. This scheme will impact on the edge of some relatively degraded blanket bog habitat but avoids all the areas of higher sensitivity.

Impacts have been minimised by running the proposed access along existing tracks, through conifer plantation and along routes with thinner peat as far as possible and moving the turbines to the east of the most sensitive areas, but the blanket bog cannot be avoided entirely. Assuming mitigation for peatland is carried out and disturbed bog habitat is fully restored, impacts to blanket bog may be considered of **Low** significance.

Wet heath is also an Annex 1 habitat and is a GWDTE type of lesser sensitivity. It occurs in mosaic with blanket bog over the north of this site in reasonable condition, and throughout the plantation areas, although it has been somewhat degraded here by tracking, conifer management and long-term herbivore impacts. However, this habitat is less fragile than the blanket bog due to its thinner peat and more robust hydrology so it is recommended that tracks and structures be sited within this habitat in preference to blanket bog. Areas of deeper peat and flushing should be avoided as far as possible.

Flushes

Acid flushes (M4, M6) and rush fen (M23) are GWDTE habitats and are present at various locations throughout the site. They are dependent on the movement of water through the ground and are sensitive to changes in hydrology.

Natural examples, from the northern peatland and alongside the burns, should be avoided as far as possible. Where this is not possible, additional measures to reinstate the features and their hydrology will be required. Micro-siting should aim to ensure that most can be avoided by an adequate margin and that, so long as the mitigation is overseen by a competent ecologist, impacts to base-rich flushes will be of **Low** significance.

The acid flushes and rush fen (M6, M23) within the felled plantation areas are typical of disturbed ground, mainly due to past drainage of the conifer block. Although they are GWDTE habitats they are derivative from past disturbance. Impacts may be considered of **Low** significance.

1. INTRODUCTION

This report describes the results of a habitat survey at the site of a proposed community wind development at Stronafian, Glendaruel, Cowal. (Grid ref NS 017 842, centred)

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The survey was carried out using a combination of National Vegetation Classification (NVC) and 'Phase 1' classification systems for vegetation communities. The survey was undertaken in June 2014 with an additional visit to check some features in August 2014. The survey covered all open areas within the area of search and extended to the edge of the dense conifer plantation that surrounded the site and along some rides as appropriate.

Further information was gathered from SNH and UKBAP websites. The data collected provides background information about the site's vegetation habitats and its conservation importance on a local, national and international scale. It also enables basic conclusions to be drawn as to the main impacts arising from the proposed developments and, where possible, suggests mitigation measures.

1.1 Vegetation description

The proposed wind turbines will be sited within an open area surrounded by commercial forestry plantation. The area supports a mosaic of open upland vegetation dominated by blanket bog and wet heath communities, together with smaller areas of acid flushes, acid grasslands, dry heaths and marsh.

Over much of the survey area, the peatland vegetation was found to be in good condition, though with moderate grazing and trampling impacts from deer and frequent argo tracks. The natural bog flora was intact, though the *Sphagnum* carpet was quite disrupted in places. It is characterised by species such as Cotton-grasses (*Eriophorum vaginatum* and *Eriophorum angustifolium*), Deergrass (*Trichophorum cespitosum*), Ling (*Calluna vulgaris*) and Bell-heather (*Erica tetralix*), together with considerable amounts of Bog-mosses (*Sphagnum* spp.). Other plants commonly found include other dwarf shrubs such as Bell-heather (*Erica cinerea*) and Blaeberry (*Vaccinium myrtillus*). The main mire communities present conform to the NVC types M17, while the wet heaths conform to the M15 type.

Acid flushes, in the form of NVC communities M6c and M6a, characterised by star sedge *Carex echinata*, Soft rush (*Juncus effusus*) and Bog-mosses (*Sphagnum* spp.) occurred mostly in small pockets throughout the area of search, usually in mosaic with blanket bog and wet heath or along the frequent, slow-moving burns across the lower slopes.

Acid grassland, in the form of U4 communities, was mainly found adjacent to the eastern burn on the better drained strips of ground of the levées. It tended to occur in mosaic with acid flushed ground (M6) and pockets of *Molinia caerulea* dominated grassland.

Very small patches of dry heath were also noted within the area of search, represented by the NVC communities H10, on the steeper southern slope of Cruach nam Mult.

Mature conifer plantations surround the site and much of the southern slopes and surrounding area is felled conifer plantation with rough *Molinia caerulea* dominated grassland and rushes growing up between the stumps.

1.2 Designations

There are no conservation designations within the area of search.

Blanket bog, Upland heathland and Upland fen, flush and swamp are UK priority BAP habitats.

1.3 Geology

The bedrock comprises quartz mica schists with some basalt intrusions that may give rise to more base-enriched flushing e.g. at springs and alongside burns that cut through rock.

1.4 Management

The open ground is managed for sheep. Grazing pressure is generally moderate-high with patches of high trampling pressure, especially on the drier grassland and through the hags. Deer are also present. The main activities in this area are connected with forestry operations and a large area to the south and east of Cruach nam Mult has been recently felled.

2. FIELD SURVEY METHODOLOGY

Field survey was carried out using the National Vegetation Classification (NVC) system with target notes taken to add further detail at relevant points. (Rodwell, 1990, 1991, 1992, 1995 and 2000).

To map the vegetation, the surveyor walked across the proposed development corridors across the site in such a way as to see a reasonable sample of all habitats and vegetation communities present, covering a large swathe of contiguous terrain encompassing all open habitat within the area of search. The boundaries of each vegetation community encountered were drawn onto maps at an appropriate scale making sure that each community was represented by a closed polygon. Where two or more communities occurred closely together in a meshed or repeating pattern they were mapped as a mosaic (e.g. M17b/M15c). Target notes were made of any unusual features, vegetation condition, rare species, management or other points of particular interest.

For highly managed habitats such as conifer plantation, and for non-vegetative features such as tracks, rock and watercourses, Phase 1 notation was used.

3. SUMMARY OF ECOLOGICAL INTEREST

3.1.1 International importance

The following habitats are listed in the EU Habitats Directive (2000) as being of international importance to nature conservation. There is therefore a presumption in favour of conserving and enhancing these habitats.

Code 7130 Blanket Bog (active)

M17 *Eriophorum vaginatum*-*Trichophorum cespitosum* blanket bog

M19 *Calluna vulgaris*-*Eriophorum vaginatum* blanket bog

M1 *Sphagnum denticulatum* bog pool community

M3 *Eriophorum angustifolium* bog pool community

Blanket bog in moderate condition with deep peat and hags is found to the north of Cruach nam Mult although it is somewhat degraded at the margins to the east and south.

Bog pools within the hags, including a larger pool, are found to the north of Cruach nam Mult and are locally important as features of natural blanket bog habitat and to provide habitat for a range of species including dragonflies, damselflies and birds.

Code 4010 Northern Atlantic wet heaths with *Erica tetralix*

M15 *Trichophorum cespitosum*-*Erica tetralix* wet heath

Wet heath occurs frequently across the area of search. It is mostly in good condition, though sometimes rather trampled, and often occurs in mosaic with blanket bog and *Molinia caerulea* tussock grassland.

Code 4030 European dry heaths

H10 *Calluna vulgaris*-*Vaccinium myrtillus* heath

Small patches of dry heath occur on steeper crags to the west of Cruach nam Mult.

3.1.2 National importance

The following habitats present on the site are also subject to national BAPs:

- Blanket bog (M17, M19, M1, M3)
- Upland flushes fens and swamps (M6d, M23a)
- Upland heathland (M15, H10)

These habitats should be retained and protected with no loss in extent or quality and enhancements made wherever possible.

3.1.3 Local importance

Blanket bog, heath, flushes, acid grassland and rivers and streams are all included in the LBAP.

3.2 Ground Water Dependent Terrestrial Ecosystems (GWDTE)

All natural and semi-natural habitats were surveyed using NVC methodology which includes all wetland habitats specified in LUPS GU4 and the SNIFFER report 2009. The extent and type of wetland habitats identified are shown in Map 3 using the broad categories as described in the SNIFFER report.

The GWDTE habitats identified are acid flushes (M6a, M6c), rush fen (M23a, M23b) and *Molinia caerulea* dominated marshy grassland (M25a), all of which are types of moderate priority (2). Wet heath (M15b, M15c) is also a GWDTE habitat of lesser priority and is ubiquitous throughout the envelope of the development.

Acid flushes and rush fen are mainly within the felled conifer plantation, and are associated with the old drains from conifer management. Rush fen (M23a/M23b) is also frequent along burns and flush routes and will require to be restored to its original condition if affected by the project. This work should be supervised by a competent ecologist.

The wet heath habitat is in quite good condition over Cruach nam Mult with a good range of typical species including constant *Calluna vulgaris* and *S.capillifolium*, although *Molinia caerulea* is very abundant. It also occurs in mosaic with blanket bog across the northern part of the site. Elsewhere it has become significantly degraded by drainage and other forestry operations. This is a relatively robust habitat and, with adequate mitigation to ensure peatland hydrology is restored with the vegetation, impacts to wet heath should not be significant.

There are no GWDTE flushes of higher priority (1) within the area of search.

4. IMPACTS

4a. Summary of impacts

The main potential impacts of the proposed developments will be as follows:

1. Disturbance and destruction of habitat during the construction phase.
2. Permanent loss of habitat at the turbines and tracks, as well as possible changes from the works such as changes to hydrology and vegetation structure.
3. Temporary disturbance of habitat by vehicle tracks including potential compression of soil.
4. Pollution of habitats and water-courses during the construction phase, including silt across peaty ground, which could affect plants throughout the run-off zone.
5. Changes to ombrogenous peat and soligenous ground water hydrology due to any drains or excavation (increased water movement, decreased water movement) that will change plant communities dependent on static/moving water and which may change the base status of the run-off water. The following impacts are predicted on habitats :
 - Linear features such as tracks and other disruption of the surface will act as a guide to water flow increasing the speed and, possibly, changing the direction of surface and ground water movement. This would lower the water table resulting in drying/oxidation of peat and reduced surface water flow. This could result in local loss of diversity on blanket bog or flushes, especially the loss of Sphagnum mosses and may favour the incursion of undesirable species.
 - An increase in the speed of water movement will act to decrease the acidity of water flowing across peatland and may increase the acidity of soakways. It would also favour rank species such as Purple Moor-grass (*Molinia caerulea*).
6. An increase in the silt content of run-off waters/burns due to increased erosion.
7. Removal of trees, woodland herbs, dead or decaying wood including standing deadwood, moss, lichen, fungus and leaf-mould.
8. The introduction into the site of wild plants or seeds, including planted trees, of non-native provenance.

4b. Detailed impacts

Table 1 - Approximate areas of habitats potentially affected

Habitat	Extent (ha)
Blanket bog	1
Wet heath	4

Acid flush	1
Marshy grassland/rush fen	4 (mainly in felled conifer)
Conifer plantation	1
Total	11

5. MITIGATION

5.1 Direct land-take

Impacts to the following items should be minimised and mitigation provided:

- **Blanket bog:** As far as possible impacts to blanket bog have been minimised by micrositing around areas of deeper peat and avoiding features such as pools. The corridor of works across peatland habitat should be kept as narrow as possible. Care must be taken to avoid compression or introducing silt to the surface ecology through silt run-off.
- **Acid flush M6:** Natural features should be provided with a buffer zone of at least 10m marked on the ground and as far as possible this habitat should be avoided by micrositing the route above any stands (e.g. keeping well back from the eastern burn). Where this is not possible, siting should aim to avoid the main areas of biodiversity and turves should be saved separately. Reinstatement should aim to recreate the habitat, its hydrology and geomorphology. Any works within the 10m buffer should be overseen by a competent ecologist according to the guidelines for flush restoration set out in Appendix 3.
- **Wet heath:** This is the dominant habitat affected by this scheme. It is largely in good condition and an Annex 1 habitat and GWDTE (least priority). The corridor through this habitat should be kept to a minimum width and care taken to restore the habitat to its original condition and to avoid introducing silt to the surface ecology through silt run-off.

5.2 During construction

Impacts due to vehicular access across unprotected ground should be minimised by:

- The use of vehicles designed to spread their load to a lowkg/m², e.g. with tracks or wide wheels. Excavators fitted with wide tracks will be used to carry out the digging.
- Wherever possible vehicles will be routed to avoid flushes, streams and soakways
- Bridges will be used in preference to culverts wherever practical, over all flushes, streams and soakways.
- Any culverts used will be made of a neutral pH material such as clay or plastic, and large enough to carry heavy flow. Alongside tracks all burns and soaks will be culverted to avoid erosion of track-sides leading to erosion and siltation. Care will be taken to avoid disturbing the soil around the streams enabling the ground water to seep naturally through the peat.
- The number of journeys made across unprotected ground will be minimised.
- All staff will be advised as to where important habitats are and provided with alternative routes to avoid crossing them. Sensitive flushes will be marked on the ground with coloured tape and flags.

Chemical damage to the vegetation by pollution will be avoided by the following measures:

- All vehicles used will be adequately maintained.

- Wherever possible, the use of polluting substances, toxins or substances which may change the base status of the ground water will be avoided.
- Construction workers will be advised of the importance of preventing spills, in particular of any substance which may enter the water table or change the base status of the groundwater such as sediments, oil, solvents or alkaline solutions (see SEPA Guidelines).
- Sediment traps and settlement ponds will be installed wherever there is the potential for silt movement, preferably installed in slower moving drains and soaks before silt-laden water can enter faster flows. Piles of gravel may be used in steeper sections, e.g. along trackside drains, to reduce flow speed and allow silt to settle. Traps must be regularly checked and maintained.

Across any wetland, in order to minimise any increased drainage created by linear features (pipeline, drains) the following steps will be implemented:

- Drains will be avoided as far as possible but, where necessary, will be dug around the contour rather than downslope.
- Peat within any excavation or trench should be returned to as near natural structure as possible. As much material will be returned to the hole as possible and tamped down very firmly to evict air and close any gaps caused by cutting.
- Cuttings alongside deep peat areas can be banded using sheets of plastic or iron piling to retain the water and prevent local drainage at the bog margins.

To avoid contamination of peat by mineral soil or imported material during excavation on peatland:

- All mineral soil dug out from the trench will be returned to the bottom and the excavated peat returned to the top to form the thickest possible layer of uncontaminated peat.
- Silt traps must be used wherever there is a chance of water carrying sediment flushing over the peat. Peat habitats are not grassland and should not be used to dump sediment laden water.

To minimise impacts to trees, herbs, dead-wood and lower plants:

- Any large native trees > 25cm dbh will be avoided as far as possible by routing the pipeline around them.
- Any standing timber of native species that has to be felled will be left in situ and not taken off-site. Felled conifers may be taken away or used to float the track.
- Deadwood, including standing deadwood, especially where supporting fungi, moss and lichen communities will not be removed from the woodland or destroyed.
- Live or dead timber felled or cut in open locations should be stacked adjacent to existing woodland blocks.
- Woodland alongside any burns and on the banks above them will be avoided.

5.3 Post construction

All vegetation will be fully reinstated following construction:

- Substrate and turves will be stored separately for each habitat, particularly for flush, peat and woodland habitat.
- Topsoil and sub-soil will also be stored separately.
- Turves will be stacked in layers no more than two turves deep and monitored to ensure they are not drying out. Dry turves should be watered as required to ensure they remain viable.
- Substrate will be returned to any excavated ground such that sub-soil is not mixed with top-soil or peat and that an adequate layer of topsoil or peat is provided for the replaced turf species to root.
- Turves of the correct habitat should be replaced as soon as possible after removal, preferably within 48 hours in dry weather, though as a maximum 14 days under normal conditions. Turves must be carefully replaced, vegetation side uppermost.
- The geomorphology of some features, particularly flush and soak-way habitats, must be correctly re-established to ensure that the original hydrology is maintained.
- Along any length of track due to be reinstated, turves will be exposed for much longer and these should be laid out no more than one turf thick, the right way up, and kept moist throughout their exposure.

To ensure appropriate mitigation is carried out and that areas of local sensitivity are avoided wherever possible, an on-site ecologist will be retained to provide advice where needed and to monitor progress during and after construction.

Table 2. The significance of impacts as a function of sensitivity, the magnitude of change and the amelioration possible by mitigation

Habitat	Sensitivity	Magnitude of change	Significance of impact (without mitigation)	Significance of impact (with mitigation)
Blanket bog	High	Low	Moderate	Low
Wet heath	Moderate	Moderate	Moderate	Low
Acid flush	Moderate	Low	Moderate	Low
Marshy grassland/rush fen	Moderate	Low	Moderate	Low

Sensitivity is a function of the relative importance to conservation of the habitats involved:

- **High** - International or national priority habitat and/or very fragile vegetation of international or national importance.
- **Moderate** – International, national or locally important habitat (EU list/BAP/LBAP)
- **Low** – semi-improved or improved habitat not subject to EU, BAP or LBAP listing

Magnitude of change is a function of the area likely to be damaged and its relative fragility:

- **High** – a change likely to result in any reduction in the extent or quality of a habitat feature within a designated area, or a significant reduction in the extent or quality of any listed habitat.
- **Moderate** – a change likely to result in a moderate reduction in the extent or quality of an internationally, nationally or locally important habitat or such that restoration of that habitat to good condition over a reasonable timescale is unlikely.
- **Low** – a change likely to result in a reduction of extent or quality of an unlisted habitat or of a listed habitat but that is likely to effect a good restoration over a reasonable timescale.

Significance of impact is a function of sensitivity & magnitude of change such that:

- **High** – any impact on a priority habitat or significant impact on a listed or fragile habitat.
- **Moderate** – moderate or small but irreversible impact on a non-priority listed habitat.
- **Low** – small or reversible impact on a non-priority listed habitat or any impact on a low priority habitat.

Mitigation describes measures by which the relative significance of any impact can be reduced.

6. CONCLUSIONS AND RECOMMENDATIONS

The main features of conservation importance at this site are the Annex 1 habitats across the open ground to the north of Cruach nam Mult. These include blanket bog with areas of deep peat, hags and pools and on slopes in mosaic with wet heath. There are frequent acid flushes (M6) and areas of rush fen (M23, M25) that are also of importance where they occur in natural, undisturbed stands outside the felled conifer plantation. The sensitivity map (Map 3) and GWDTE map (Map 4) indicate the main areas of concern.

Access to the scheme has been routed as far as possible along existing tracks, and through forestry and the new tracks to the turbine locations have been sited outside the areas of deeper peat to avoid the features of higher sensitivity.

The proposed micro-siting and mitigation around sensitive areas will mean that there will be minimal long-term impacts to blanket bog and wet heath, from land-take of the turbines or from access tracks, most of which have been routed through degraded habitat and felled conifer plantation. There may be some short-term disruption of the peatland hydrology. So long as habitats are fully restored and the layout continues to avoid the more sensitive areas, impacts are predicted to be of **Low** significance.

Acid flushes, marshy grassland and rush fen (M6, M23, M25) criss-cross the site due to forest drainage channels and will be impossible to avoid. Natural flushes and fens along the eastern burn have been avoided as far as possible by micro-siting and will be clearly marked on the ground with a 10m buffer prior to construction. For those it has not been possible to avoid, mitigation should aim to reduce tracking and ensure good restoration of habitat and hydrology, and will need to be overseen by a competent ecologist. Assuming that this can be achieved, impacts to GWDTE habitats should be **Low**.

7. REFERENCES

- EC DGX1 1996.** Interpretation manual of European Union Habitats vers EUR 15.
- Highland Council 2004.** The Ross & Cromarty (East) Biodiversity Action Plan.
- Perring F.H. & Walters S.M. 1990.** Atlas of the British Flora, BSBI.
- Rodwell J.S. 1990.** British Plant Communities Vol. 1. Woodlands. Cambridge University Press.
- Rodwell J.S. 1991.** British Plant Communities Vol. 2. Mires and Heaths. Cambridge University Press.
- Rodwell J.S. 1992.** British Plant Communities Vol. 3. Grasslands and Montane Communities. Cambridge University Press.
- Scottish Executive 2000.** Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds (The Habitats and Birds Directive).
- SEPA LUPS GU4 2010.** Guidance for Groundwater unit Staff and Ecologists when assessing the impacts of windfarms on groundwater and associated receptors.
- SNH Site Management Statement - Fannich Hills (2010)**
- SNIFFER 2009.** WFD95 A Functional Wetland typology for Scotland (SEPA)
- Stace C. 1997.** New Flora of the British Isles (2nd edition). Cambridge University Press.
- Stewart A., Pearman D.A. & Preston C.D. 1994.** Scarce Plants in Britain. JNCC Peterborough.
- Stone, P. 2008.** Bedrock Geology UK North. British Geological Survey, Keyworth.
- Water Framework Directive (WFD) DIRECTIVE 2000/60/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 23 October 2000**
establishing a framework for Community action in the field of water policy
- Water Environment & Water Services (Scotland) Act 2003 (WEWS)**

APPENDIX 1 – TARGET NOTES

Target note	X	Y	Note
1	201757	683776	Old water vole burrows, 2, inactive
2	201703	683723	Old water vole burrow
3	201564	683963	Craggy outcrop covered in heather H10a and moss/lichen assemblage. Avoid.
4	201540	684003	M6bi flush in old drain
5	201623	684391	Large pool in blanket bog, M1 and M4 with some <i>Glyceria fluitans</i> and <i>Potamogeton polygonifolius</i> at the margins and in adjacent runnels, <i>Carex rostrata</i> , <i>Sphagnum denticulatum</i> , <i>Sphagnum cuspidatum</i> , <i>Narthecium ossifragum</i> , <i>Sphagnum papillosum</i> , <i>Carex nigra</i> .
6	201654	684348	Blanket bog in valley bottom, very frequent pools M1.
7	201620	684429	Extensive hag system of old, largely revegetated hags, large peat hummocks and mounds of <i>Racomitrium lanuginosum</i> . M17a/b and M1 pools, great condition, pristine habitat.
8	201843	684111	8 water vole burrows that may be active or relatively recent - no feeding signs or latrines, will check in June.
9	201845	683977	Otter hole in burn, probably lie-up, no sign recent use.
10	201804	683831	Pine marten scat on track, several scats locally.

APPENDIX 2: SPECIES LIST

<i>Agrostis capillaris</i>	Brown bent
<i>Agrostis canina</i>	Velvet bent
<i>Anthoxanthum odoratum</i>	Sweet vernal-grass
<i>Athyrium filix-femina</i>	Lady fern
<i>Betula pubescens</i>	Downy birch
<i>Blechnum spicant</i>	Hard fern
<i>Calluna vulgaris</i>	Ling heather
<i>Carex viridula</i> sbsp. <i>oedocarpa</i>	Yellow sedge
<i>Carex echinata</i>	Star sedge
<i>Carex nigra</i>	Common sedge
<i>Carex panicea</i>	Carnation sedge
<i>Cirsium palustre</i>	Marsh thistle
<i>Deschampsia cespitosa</i>	Tufted hair grass
<i>Deschampsia flexuosa</i>	Wavy hair-grass
<i>Dicranum majus</i>	Greater Fork-moss
<i>Digitalis purpurea</i>	Foxglove
<i>Drosera rotundifolia</i>	Round-leaved sundew
<i>Erica cinerea</i>	Bell heather
<i>Erica tetralix</i>	Cross-leaved heath
<i>Eriophorum angustifolium</i>	Broad-leaved cotton-grass
<i>Eriophorum vaginatum</i>	Hare's-tail cotton-grass
<i>Festuca ovina</i>	Sheep's fescue
<i>Festuca rubra</i>	Red fescue
<i>Galium saxatile</i>	Heath bedstraw
<i>Holcus lanatus</i>	Yorkshire fog
<i>Hylocomium splendens</i>	Glittering Wood-moss
<i>Juncus acutiflorus</i>	Sharp-flowered rush
<i>Juncus bufonius</i>	Toadrush
<i>Juncus bulbosus</i>	Bulbous rush
<i>Juncus effusus</i>	Soft rush
<i>Juncus squarrosus</i>	Heath rush
<i>Luzula multiflora</i>	Many-flowered wood-rush
<i>Molinia caerulea</i>	Purple moor-grass
<i>Nardus stricta</i>	Mat grass
<i>Narthecium ossifragum</i>	Bog asphodel
<i>Pedicularis sylvatica</i>	Lousewort
<i>Pinguicula vulgaris</i>	Butterwort
<i>Plagiothecium undulatum</i>	Waved Silk-moss
<i>Pleurozium schreberi</i>	
<i>Poa annua</i>	Rough meadow grass
<i>Polygala serpyllifolia</i>	Common milkwort
<i>Polytrichum commune</i>	Common Haircap
<i>Potentilla erecta</i>	Tormentil
<i>Racomitrium lanuginosum</i>	Woolly Hair-moss
<i>Ranunculus acris</i>	Meadow buttercup
<i>Ranunculus repens</i>	Creeping buttercup
<i>Rhytidiadelphus squarrosus</i>	Springy Turf-moss
<i>Rhytidiadelphus loreus</i>	Forest turf-moss
<i>Salix aurita</i>	Eared willow
<i>Salix cinerea</i>	Grey willow
<i>Sorbus aucuparia</i>	Rowan
<i>Sphagnum capillifolium</i>	Red Bog-moss
<i>Sphagnum cuspidatum</i>	

<i>Sphagnum denticulatum</i>	<i>Cow-horn Bog-moss</i>
<i>Sphagnum palustre</i>	
<i>Sphagnum papillosum</i>	
<i>Sphagnum recurvum</i>	
<i>Succisa pratensis</i>	<i>Devil's bit scabious</i>
<i>Thuidium tamariscinum</i>	
<i>Trichophorum cespitosum</i>	<i>Deer grass</i>
<i>Vaccinium myrtillus</i>	<i>Blaeberry</i>
<i>Viola riviniana</i>	<i>Common Dog-violet</i>
<i>Viola palustris</i>	<i>Marsh violet</i>

APPENDIX 3 - GWDTE FLUSH MITIGATION

Specific mitigation for dealing with GWDTE flush habitats

Ideally, GWDTE habitats should be avoided by construction works as they are sensitive to changes in ground-water hydrology. All examples of these habitats should be clearly identified on the ground and, if not obvious, should be clearly marked with high visibility tape so that they can be micro-sited around.

For flushes of high priority (*sensu UKTAG 2003*) such as M10 flushes or M32 springs, or natural wetland features such as M6 and M23 mires, a buffer zone of 10m is recommended around any feature and the pipeline and associated works should be no closer to prevent disturbance. In addition, where flush features are the result of particular conditions, such as base-enrichment, the source of that condition should also be identified and included with the protection.

However, since flushes are often linear features that run across a track or pipeline route with its own constraints, such as to maintain the required gradient, there will be cases where avoidance is not possible. In this case, mitigation (set out below) aims to avoid any impacts to the source of the ground-water feature, to minimise disturbance to the feature during construction and to ensure that restoration will include restoring the correct vegetation and reshaping the flush so that the ground and surface water flows through the feature can be re-established.

Mitigation for passing through a GWDTE flush

- Each flush and its source should be marked with a physical barrier at least 10m away to highlight their location and prevent unplanned disturbance.
- The flush should be approached from either side using boards to protect the vegetation and not crossed unnecessarily.
- The vegetation from the flush will be stored separately during the excavation and that should be completed in no more than 48hrs.
- If done in dry weather or if there are any delays beyond this time, there may need to be some watering of the turves to keep them wet.
- The slight depression that channelled the flush across the peat will need to be carefully reformed.
- The peat and turves should be replaced as they were taken out, with any flush turves replaced along the original line of the flush.
- The excavation and restoration should be completed with the ECOW present.

General mitigation

During construction, impacts due to vehicular access across unprotected ground will be minimised by:

- The use of vehicles designed to spread their load to a low Kg/m², e.g. with tracks or wide wheels. Excavators fitted with wide tracks should be used to carry out the digging.
- Wherever possible vehicles will be routed to avoid flushes, streams and soaks.
- Culverts used will be made of a neutral pH material such as clay or plastic, and large enough to carry heavy flow. Alongside tracks all burns and soaks will be culverted to avoid erosion of track-sides leading to erosion and siltation. Care will be taken to avoid disturbing the soil around the streams enabling the ground water to seep naturally through the peat.
- The number of journeys made across unprotected ground will be minimised.

- All staff will be advised as to where important habitats are and provided with alternative routes to avoid crossing them.
- In particular, areas of calcareous grassland should be highlighted and avoided during construction, most notably at the powerhouse site.

Chemical damage to the vegetation by pollution will be avoided by the following measures:

- All vehicles used will be adequately maintained.
- Wherever possible, the use of polluting substances, toxins or substances which may change the base status of the ground water will be avoided.
- Construction workers will be advised of the importance of preventing spills, in particular of any substance which may enter the water table or change the base status of the groundwater such as oil, solvents or alkaline solutions (see SEPA Guidelines).

To minimise the increased drainage created by linear features (pipeline, drains) the following steps will be implemented:

- Drains will be avoided as far as possible but, where necessary, will be dug around the contour rather than downslope.
- When laying pipeline, turves will be cut leaving the vegetation intact and replaced as soon as possible, ideally on the same day.
- Turves will be stacked at a different location from the underlying peat and sub-soil.
- To prevent the pipeline from channelling the water along it, the peat within the trench will be returned to as near natural structure as possible. As much material will be returned to the trench as possible and tamped down very firmly to evict air and close any gaps caused by cutting.
- Vegetation turves will be cut in an irregular pattern to prevent surface lines which may channel flow.

To avoid contamination by sub-soil, sediment or imported material during excavation:

- All mineral soil dug out from the trench will be returned to the bottom and not mixed with the top layers or turves.
- Silt traps will be placed wherever there is water flowing out of the construction site that may carry sediment into water-courses or across the surface of any peatland or flush habitat.

Scottish Executive 2000. Nature Conservation: Implementation in Scotland of EC Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna and the Conservation of Wild Birds (The Habitats and Birds Directive).

SEPA LUPS GU4 2010. Guidance for Groundwater unit Staff and Ecologists when assessing the impacts of windfarms on groundwater and associated receptors.

SNIFFER 2009. WFD95 A Functional Wetland typology for Scotland (SEPA)

UK TECHNICAL ADVISORY GROUP ON THE WATER FRAMEWORK DIRECTIVE (2003) Guidance on the identification and risk assessment of groundwater dependent terrestrial ecosystems

APPENDIX 4: MAPS



