Technical Appendix 9.3: Groundwater Dependent Terrestrial Ecosystem Assessment

Technical Appendix 9.3: Groundwater Dependent Terrestrial Ecosystem (GWDTE) Assessment

9.3.1 Introduction

9.3.1.1 This technical appendix provides a summary of Groundwater Dependent Terrestrial Ecosystems (GWDTEs) within the context of the proposed repowering of the Novar 1 Wind Farm (the 'Proposed Development'). This assessment provides a description of geological and hydrogeological conditions underlying the Site. Characterisation of the Proposed Development area considers National Vegetation Classification (NVC) surveying conducted by Ramboll in June 2024 and hydrological surveying carried out by Ramboll in June 2024.

9.3.1.2 The assessment of GWDTE has been carried out in line with SEPA Guidance on Assessing the Impacts of Development Proposals on Groundwater Dependent Terrestrial Ecosystems.

9.3.1.3 To identify any potential GWDTE vegetation communities are present on the Site a National Vegetation Classification (NVC) survey has been completed. This has been used to compile a list of NVC communities that may be dependent on groundwater.

9.3.1.4 To further assess whether NVC GWDTE vegetation communities are reliant on groundwater supplies the following factors have been taken into consideration (based on desk-based GIS assessment of the Site and findings of both an ecological and hydrological site walkover):

- The productivity of the underlying geology;
- The presence of springs or visible groundwater emergence;
- Direct connectivity to surface water features and overland flow paths;
- Visual indications of waterlogging on otherwise well drained slopes;
- Alignment of GWDTE vegetation communities with concave breaks in slope; and
- Indications of diffuse groundwater emergence along linear geological features.

9.3.1.5 Following the initial identification of habitats with a potential to be GWDTEs based on NVC mapping data, the hydrological and hydrogeological desktop study information has then been used to qualitatively determine the likely dependency on groundwater bodies and therefore the sensitivity of each potential GWDTE.

9.3.2 Baseline

Bedrock Geology

9.3.2.1 The British Geological Survey (BGS) 1:50,000 Digital Geological Map of Great Britain[1] shows bedrock geology underlying the Site, where development is proposed, to be of the Tarvie Psammite Formation, comprising of metamorphic psammites. Land on the east of the Site is underlain by bedrock geology of the Ousdale Arkose Formation, comprising Breccia and Sandstone. Whilst small areas of land in the northern and central areas of the Site are underlain by the Ben Wyvis Pelite Formation, comprising of Pelite and Semipelite. However, no development is proposed in these areas.

Superficial Geology

9.3.2.2 The BGS 1:50,000 Digital Geological Map of Great Britain shows that the majority of the Site to be underlain by peat deposits. This is supported by findings of peat surveying conducted by Ramboll in May 2024. Superficial deposits of Till and Morainic are also recorded across small areas of the Site. However, no development is proposed in this area.

9.3.2.3 Peat soils are recorded on the National Soil Map of Scotland Carbon and Peatland Map (2016)[2] across the Site. The majority of the Site is underlain by peat soils classified as being Class 1. Class 1 peat is designated as being '*nationally important carbon rich soils, deep peat and priority peatland habitat' Areas likely to be of high conservation value'*. Smaller areas of Class 5 peat are also shown in the centre and south of the Site, which are described as 'peat soils'.

Hydrogeology

9.3.2.4 According to the BGS and the Hydrogeological and Groundwater Vulnerability Maps of Scotland (1:625,000), the underlying bedrock formation is recognised as a low productivity aquifer. Such aquifers are characterised as having limited groundwater potential, with small amounts of groundwater limited to near surface weathered zones and secondary fractures (e.g. rare springs). Low productivity aquifers do not widely contain groundwater in exploitable quantities; however, some bedrock formations can locally yield water supplies in sufficient quantities for private/domestic use. The route of the existing Access Route crosses an area assessed to be of moderate productivity, comprising a 'locally important multi-layered aquifer'.

9.3.3 Groundwater Dependent Terrestrial Ecosystems

9.3.3.1 Five areas with a potential to be Moderately GWDTE and three with a potential to be Highly GWDTE habitat areas were identified during NVC surveys conducted by Ramboll in June 2024. Further details on each GWDTE identified are provided below.

9.3.3.2 Following identification of habitats with potential to be GWDTEs from NVC mapping data (**Figure 9.7: NVC Classification (EIAR Volume 3a)**), the hydrological and hydrogeological desktop study information has been used to help qualitatively determine the potential sensitivity of each potential GWDTE.

9.3.3.3 Where a mosaic of NVC classifications was observed, only the community occupying the largest proportion of the mosaic has been considered as representative of the potential for the mosaic to be a GWDTE (**Figure 9.8, NVC GWDTE High Classification (EIAR Volume 3a)**). Ecological surveying has been carried out on-Site, up to 250 m from the infrastructure for the Proposed Development.

9.3.3.4 The sensitivity of each GWDTE receptor has been classified in accordance with SEPA guidance LUPS – GN31[3]. The SEPA classification is modified from the UKTAG (2008)[4] list of NVC communities, which provides the full list for all communities. The relevant UKTAG classification is also provided.

1 Available at British Geological Society: GeoIndex (Onshore): https://www.bgs.ac.uk/map-viewers/geoindex-onshore/

2 Scottish Government. Scotland's Soils – Soil Maps. National soil map of Scotland [Online]. Available at: https://map.environment.gov.scot/Soil_maps/?layer=1

3 Scottish Environment Protection Agency, 2024. Guidance on Assessing the Impacts of Development Proposals on Groundwater Dependent Terrestrial Ecosystems

4 Guidance within 'Guidance on Assessing the Impacts of Development Proposals on Groundwater Dependent Terrestrial Ecosystems' is adapted from 'UK Technical Advisory Group list of NVC communities and associated groundwater dependency scores (2008)

9.3.3.5 Table 9.3.1 sets out the two NVC communities which are considered to have the potential to be a GWDTE and which have therefore been assessed further.

Table 9.3.1: NVC Communities Present within the Study Area and their Potential Groundwater Dependency, According to SEPA and UKTAG

NVC Code	NVC	Groundwater Dependency (SEPA)	Groundwater Dependency (UKTAG/Scotland)
M7	*Carex curta–Sphagnum russowii mire*	High	High
M15	*Scirpus cespitosus–Erica tetralix wet heath*	Moderate	Moderate

M7 Carex curta – Sphagnum russowii mire

9.3.3.6 Three areas of M7 upland flushes were recorded in the central area of the Site two of which are located adjacent to the Allt Srath nan Gleann watercourse and a tributary of the watercourse. These habitats are therefore in direct connection to surface waters which are likely to represent the primary source of water supply for habitats. The third M7 community is situated on level ground but within rills and ditches which provide a flow pathway from upslope areas of rainfed habitat, and which form ephemeral flow pathways. Additionally, all three areas of M7 habitat are located within areas of rainfed peatland (deep peat) which are indicative of ombrogenous habitat. The presence of the M7 communities in this hydrological setting suggests that they are most likely reliant upon surface drainage pathways.

9.3.3.7 As a result of these observations, it is considered that the M7 communities recorded on-Site are **not groundwater dependent**.

M15 Scirpus cespitosus – Erica tetralix wet heath

9.3.3.8 Five areas of M15 wet heath communities were recorded in the northwest area of the Site. Three of these are present on the southern slope of Meall an Tuirc, they are situated downslope of a number of rills and ditches which represent a source of surface water supply from upslope areas. A second area of M15 vegetation is present on the northern slope of Meall an Tuirc, hydrology survey results recorded the ground to be boggy underfoot however no groundwater emergence was present. The absence of groundwater emergence and the underlying geology are indicative of rainfed habitats. The fifth area identified to be of moderate groundwater dependency is also located on the northern slope of Meall an Tuirc, this area comprises a number of rills and ditches which provide a flow pathway from upslope areas of rainfed habitat, and which form ephemeral flow pathways.

9.3.3.9 As a result of these observations, it is considered that the M15 communities recorded on-Site are **not groundwater dependent**.

9.3.3.10 According to site specific ecological conditions, Table 9.3.2 describes the NVC communities present within the study area and their potential groundwater dependency.

Table 9.3.2: NVC Communities Present within the Study Area and Their Groundwater Dependency, According to Site-specific, Ecological Conditions

NVC Code	NVC Community	Ramboll Groundwater Dependency Assessment
M7	*Carex curta–Sphagnum russowii mire*	Not Groundwater Dependent
M15	*Scirpus cespitosus–Erica tetralix wet heath*	Not Groundwater Dependent

9.3.4 Groundwater Dependency

9.3.4.1 UKTAG guidance[5] recognises that most "water dependent terrestrial ecosystems lie along a continuum between always only groundwater dependent and always only surface water dependent". "The source of water supply for some wetlands does not appear to be critical, therefore the task of identifying dependence upon groundwater is sometimes complex."

9.3.4.2 SNIFFER (2007) guidance[6] states that the dependence of wetlands on groundwater bodies is a result of hydrological connectivity. The degree of dependency will vary depending on whether the wetland is underlain by a low productivity or high productivity aquifer and whether there is a hydrological linkage mechanism between groundwater and the surface wetland. Likelihood of dependency is based upon the following:

- High Likelihood: characterised by intergranular, high productivity drift aquifer and dominantly intergranular, highly productive aquifer;
- Moderate Likelihood: characterised by intergranular, moderate productivity drift aquifer and fractured, very low productivity aquifer; and
- Low Likelihood: characterised by intergranular, very low productivity drift aquifer and fractured, very low productivity aquifer.

9.3.4.3 The Site is underlain by bedrock aquifers with low productivity where the flow is virtually all through fractures and other discontinuities. Where drift deposits are present within the Site, these would be of low productivity. Therefore, it is assumed that there is low likelihood of groundwater dependency for all the GWDTEs within the Site, based on assessment of underlying hydrogeology.

9.3.4.4 The UKTAG (2004) guidance provides criteria for identification and inclusion of GWDTEs in the risk assessment process, based on complementary ecological and hydrogeological assessments. These criteria have been used to produce the following matrix (Table 9.3.3), which provides an identification of sensitive and potentially sensitive GWDTEs that require a qualitative assessment to ascertain the significance of the risks the Proposed Development poses to them.

[5] UKTAG list of NVC communities and associated groundwater dependency scores (2008)' contains a full list for all NVCs with Scotland groundwater dependency scores.

[6] SNIFFER (2007) WFD66 – Wetland Hydrogeomorphic Classification for Scotland. Edinburgh: SNIFFER.

Table 9.3.3: Matrix for Identification of Sensitive GWDTEs from Ecological and Hydrogeological Assessments				
		Hydrogeological Assessment Groundwater Dependency Level		
		High Likelihood	**Moderate Likelihood**	**Low Likelihood**
Ecological Assessment of NVC Communities	**Potential to be Highly Groundwater Dependent**	Sensitive GWDTE	Potential Sensitive GWDTE	Potential Sensitive GWDTE
	Potential to be Moderately Groundwater Dependent	Potential Sensitive GWDTE	Potential Sensitive GWDTE	Not Sensitive
	Not Groundwater Dependent	Potential Sensitive GWDTE	Not Sensitive	Not Sensitive

9.3.4.5 Since the likelihood of groundwater dependency is considered to be Low for all of the potential GWDTEs across the Site, in line with underlying hydrogeological conditions (as specified in SNIFFER (2007) guidance), all the areas identified in the ecological assessment of NVC communities as potential Moderately GWDTEs are considered not sensitive (Table 9.3.3) and have therefore been excluded from further assessment.

9.3.4.6 Whilst habitats with a potential to be Highly dependent based on NVC survey could remain potentially sensitive even if the hydrogeological assessment suggests a low likelihood of dependency, this can be refined further. As the only potential Highly GWDTE identified (M15) are directly associated with surface water features, this area is also considered not to be sensitive with respect to groundwater supplies (Table 9.3.4). Ramboll's assessment of Groundwater Dependency is shown in **Figure 9.9: Ramboll GWDTE Classification (EIAR Volume 3a).**

Table 9.3.4 GWDTE Sensitive Assessment			
NVC Code	**NVC Community**	**Ramboll Groundwater Dependency Assessment**	**GWDTE**
M7	*Carex curta–Sphagnum russowii mire*	Not Groundwater Dependent	Not Sensitive
M15	*Scirpus cespitosus–Erica tetralix wet heath*	Not Groundwater Dependent	Not Sensitive

9.3.5 Mitigation and Further Assessment

9.3.5.1 As the potential GWDTE areas assessed are not considered likely to be groundwater dependent, specific mitigation with respect to groundwater supplies is not considered to be applicable.

9.3.5.2 It is noted that the locations assessed are in connection with peat bogs and areas of deep peat which were recorded through peat surveying. As such, it is considered that the maintenance of quality and quantity in surface water distribution across these areas will be important. Suitable drainage and surface water measures would be used to maintain hydrological connectivity in peatland and wetland habitats and prevent deleterious impacts on surface water distribution. Mitigation measures would include those presented in the **Outline Decommissioning and Construction Environmental Management Plan** (**Appendix 3.1 of Volume 4 of the EIAR)** and cover the following:

- Avoidance of direct impacts by construction activity in such areas;
- Implementation of Sustainable Drainage System (SuDS) measures to maintain quality of water supply;
- Maintenance of flow paths/redistribution of water where diverted;
- Implementation of pollution control measures; and
- Demarcation of the most sensitive habitat areas identified in ecological surveying, and monitoring of works in close proximity by the Ecological Clerk of Works (ECoW).

9.3.6 Conclusions

9.3.6.1 The hydrogeological assessment of potential GWDTEs concludes that all of the areas identified by the ecological assessment of NVC communities as potential GWDTEs are considered to have a low likelihood of groundwater dependency. Consequently, these areas are considered to be of a low sensitivity in the context of the Proposed Development and therefore an assessment of GWDTE will not be included in the EIAR chapter.